Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLI. NEW YORK, SATURDAY, JANUARY 24, 1903. No. 4.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE Hastings House, Norfolk St., Strand, London, England.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - -	per year, $3.00
Foreign Countries, within the Postal Union - - - - - -	6.00
Great Britain and Ireland - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1902, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, JANUARY 24, 1903.

CONTENTS.

Editorial 143
Telegraph Lines along Railways 146
Municipal Ownership and Public Franchises 146
Water Power on the Winooski. By Alton D. Adams 147
Stresses on Frames of Alternating Current Generators. By P. J. Frenell 148
The Evolution of the Modern Telephone System. By L. A. Lindsey 150
Results with Third Rail in Boston 151
The Underground System of the Chicago Edison and Commonwealth Electric Companies 152
Berliner Decision 154
The Street Railways of Massachusetts 155
Solution of a Vexatious Problem in Street Railway Work. By W. B. Arthur 155
The Construction of Aerial Telephone Lines—II. By Arthur V. Abbott, C. E. 156
Opinions on the Berliner Decision 158
Recent Electrochemical Developments. By Clinton Paul Townsend 159
New Telephone Patents 159
Wireless Telegraph Message from President and King 161
Current News and Notes 161
LETTERS TO THE EDITORS:
The Making of Electrical History. By Charles Herman 162
Electric Roads in Sweden. By Arvid Westerberg 162
Digest of Current Electrical Literature 163
Bitumenized Fibre Conduit 167
The Annual New York Automobile Show 167
Richardson Automatic Scales 170
Incandescent and Arc Lamp Fittings 170
DEPARTMENTS:
Financial Intelligence 171
Commercial Intelligence 172
General News 174
Trade Notes 177
Record of Electrical Patents 178

THE AUTOMOBILE SHOW.

The magnitude of the automobile show at Madison Square Garden this week, and the great attendance, must be a source of intense gratification to all interested in the art, whatever may be the particular branch to which they devote attention. There is no denying that gasolene types predominate greatly and exhibit marked improvement in every respect, but as they depend in no small degree on electrical accessories, their increasing number is a help to those branches; while the newer form of combined gasolene and electric machine presents many hopeful aspects. It does not seem to us that steam is making much headway, although it is undeniably a good power for a stiff hill. We regard the general outlook for electricity as still excellent, and any one familiar with the subject cannot but note the steady improvement in vehicles of the electrical class, with the known and standard appliances now available. The resources of the art are far from being exhausted, however, and as has been pointed out in regard to steam locomotives, electricity is virtually beginning where steam has left off, having in most respects completed all its possible cycles of improvement in the matter of transportation on land. Be this as it may, the automobile show is most encouraging to all who wish to see the horse relieved entirely from work within city limits, where its presence becomes less and less desirable, or even tolerable. That which the trolley car has done, the automobile must second; and if electricity can play as large a share in the newer art, we shall be fairly well satisfied.

THE BERLINER DECISION.

The decision rendered in Boston last week in the Berliner case terminates in all probability a *cause celébre* which, within and without the Patent Office, has had a term of more than a quarter of a century. It is true that the case could be reopened by the United States Supreme Court—either by accepting a certification to its jurisdiction or by ordering such certification—but as the Boston case just decided appears to have involved only a determination of facts and not a great principle in law, the probability of such an eventuality is very remote. Indeed, one might well believe that in view of the short remaining life of the patent, rather than having a desire to reopen the case, the Bell Company feels an immense relief at the removal of the burden of an issue which has entailed enormous expense with no return—at least in recent years—and has evoked intense hostility against the company. The history of the Berliner patent begins with an application filed June 4, 1877, the application having been preceded by three caveats dated respectively, April 4, April 30 and May 9, of the same year. It was not until more than fourteen years later, namely November 17, 1891, that the patent was issued. During this long delay in the Patent Office, the application was constantly the subject of proceedings, which subsequently gave rise to direct charges of fraud that figured very largely in the course of the litigation just closed. The issue of the patent, controlling as it did the entire art of telephony for a period of seventeen years, naturally produced a sensation, and force of public opinion led the government to institute in February, 1893, a suit for its annulment.

Judge Carpenter, of the Circuit Court, sitting in Boston, handed down on December 16, 1894, a decision in this suit invalidating the patent on the grounds that its issue from the Patent Office had been dishonestly delayed, and that both in function and device the in-

vention covered is identical with that described in another patent issued to Berliner in 1880. Seventeeen months later—May 18, 1895—this decision was reversed by the Circuit Court of Appeals, the opinion in this instance holding that the delay in issue must be ascribed to the Patent Office system; that no proofs of gross error or fraud were shown, and that in the absence of any showing of fraud the government was barred from contesting the validity of the 1891 patent on the grounds of its identity with the patent of 1880. It is interesting to note that Judge Colt, who wrote the opinion of last week, concurred in the above decision. Owing to the important questions of law involved, the Supreme Court ordered the issue within its jurisdiction and on May 10, 1897, handed down a decision sustaining the position of the lower court, the grounds taken being that the government in its case had not established the existence of fraud; that the patentee could not be held responsible for dilatory action on the part of Patent Office officials; and that as to the 1880 patent, the government is bound by the decision of its Patent Office, which was that the 1880 and 1891 patents cover separate inventions. This ended the government case, the outcome of which was predicted from the start, and the issue was left in practically the same condition as when the patent was granted six years before.

In the meantime, several actions charging infringement of the Berliner patent had been brought; these were finally consolidated in one case and on the issues involved, Judge Brown handed down an opinion February 27, 1891, declaring the Berliner patent invalid. The grounds taken were that Berliner at the date of the patent application had not made the invention covered by the patent as issued; that the invention in the patent is radically different from that in the application, the transformation having been made after the Edison carbon microphone was invented and described; that the invention described in the 1891 patent is identical with that described in the patent of 1880; and finally, that Edison is the prior inventor of the microphone. The case then came, in due course, before the United States Circuit Court of Appeals sitting in Boston, and the decision of last Friday marks the last stage of the celebrated litigation.

This final opinion is the most interesting of any that has been rendered in the case, for it not only goes to the heart of the matter by considering the underlying principles of the microphone, but also treats the work of Hughes in great detail. As will be seen in the summary of the opinion printed elsewhere in this issue, the court ignores the esoteric theories that have been advanced to sustain the "constant-contact, variable-pressure" view of microphonic action, and ascribes it solely to a loose and varying contact. We are inclined to believe that this verdict from a non-scientific tribunal will stand as against the varying-infinitesimal-gas-film theory, the variable-molecules-in-contact theory and the varying-carbon-resistance theory. The opinion in no uncertain terms assigns to Hughes the discovery of the microphonic principle and no less decidedly credits the invention of the commercial microphone to Edison. It will be recalled that the Edison carbon microphone patents were issued May 3, 1892, but were void *ab initio* owing to the expiration previous to their grant of an English patent on the same invention. The course of the previous litigation had appeared to indicate so clearly the ultimate fate of the Berliner patent that the effect of the recent decision has been largely discounted. It seems likely, however, to strengthen the independent movement by removing a doubt which has had some influence with the more conservative class of capitalists.

STRESSES ON FRAMES OF ALTERNATING-CURRENT GENERATORS.

A few years ago dynamos were of such relatively small dimensions and power that when enough iron was employed in them to meet magnetic requirements, they were generally structurally strong enough to resist the mechanical forces of operation. As soon as the magnetically satisfactory structure was mounted on a conveniently shaped bed plate holding the bearing pedestals, the machine was ready for business. Now, however, dynamos are acquiring such large dimensions that some of them are built with the aid of transit instruments, and the mechanical structure calls for special engineering in addition to the electromagnetic design. The modern large dynamo touches upon the work of the bridge-builder in its mechanical design, as well as on the work of the electrical engineer. In other words, the designing electrical engineer has to study the properties and principles of large arched structures. The article on page 148 of this week's issue, by Mr. P. J. Frenell, deals with this question of mechanical design for the purpose of reducing unnecessary weight and cost in the construction of large machines.

PAPERS ON TELEPHONY WITH THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

It is noteworthy that a paper on telephony as applied in the Bell system was read this week before the American Institute of Electrical Engineers. There has been a very noticeable and regrettable dearth of such papers in the past, and it is to be hoped that the new example will esablish a new precedent and precept. Telephony has been a rapidly growing science and art, and to stifle its technical aspirations by wilful suppression of intelligent information is to commit a barbarous anachronism. The day has long gone by when the scientific facts of commercial enterprises could be concealed. If history speaks truthfully, the secret of the compounding of Greek-fire was kept successfully in the arsenal at Constantinople by the Moslem sachems for six hundred years, although the substance had value in warfare and gave an appreciable advantage to Mahommedan ships in naval conflicts. In the present age such a secret could hardly be kept for six weeks. It is notorious that the only secret processes that can be safeguarded are those capable of being carried out by a single individual. In telephony any device employed must necessarily be known or at least accessible to numerous persons, and the essential facts about such devices are, therefore, obtainable whenever sufficient earnest attention is directed to their scrutiny.

Many of the problems which the telephone engineer encounters are akin to those met with in heavier electrical engineering, and the methods and experiences of the engineer who directs microamperes may be instructive as well as interesting to him who directs kiloamperes. Consequently it is only fair that the technical knowledge of the one should be placed at the disposition of the other. The telephonists have not hesitated to employ and import the dynamos of their more electrically energetic confrères, and in nearly every telephone central station the dynamo reigns supreme in the basement or power room. It is at least but just that the utilities that peculiarly pertain to telephony should be equally made available to the power engineers. The independent telephone men realize the advantages to be gained by the dissemination of accurate information, even among themselves. They convene, read papers and contribute articles to periodicals with manifest mutual satisfaction and support. The great advance of the art of telephony since the independent movement has gained strength undoubtedly owes much to this enlightened policy. Much might yet be gained by the art and science

of telephony if all the votaries acted in this manner; and it is to be hoped, in the interests of civilization, that the sphinx-like reticence of the past will be overshadowed by a broader future policy.

PATENT OFFICE EXAMINERS.

It is a somewhat singular fact that notwithstanding the great output of our technical schools, the United States Patent Office finds difficulty in recruiting its corps of examiners. As raw material, the technical graduate is pre-eminently qualified for the duties, and the entrance examination should for one of his training not be viewed with trepidation. It is true that as a life career, the position of patent examiner holds forth no particular attractions, but as a training for a subsequent career in other walks, it offers most decided advantages. Many well-known engineers laid the foundation of their success in the Patent Office, and the most successful recruits to the ranks of patent attorneys and technical experts have in recent years come from this source. It happens very fortunately that the night course in law in the Columbian University offers an admirable opportunity to those who would add the knowledge necessary to fit for the legal branch. The authorities of those schools which keep on the lookout for openings for graduates could not do better than investigate this avenue in the interest of their protegés.

EXCITATION OF ASYNCHRONOUS GENERATORS BY CONDENSERS.

On page 109 of last week's issue we published an article on this subject by Mr. A. S. McAllister. It is well known that the asynchronous induction machine requires field excitation similar to that of an ordinary alternator, whether the machine acts as a motor or as a generator. The field excitation is nearly in quadrature with the working current, and is therefore a "wattless current." It is this relatively large wattless current of excitation that constitutes an objection to the use of induction motors. Various plans have, from time to time, been suggested for exciting induction motors locally, so as to obviate the necessity of supplying them with wattless currents, and thereby to increase their power-factor. Nevertheless, nearly all the induction motors employed up to this date have no excitation except that due to wattless line currents. The plan outlined in the article referred to consists in connecting condensers with induction machines in such a manner that the condensers will locally and automatically cause the exciting quadrature currents to flow, and thus enable the machine to operate without line excitation. The broad plan was suggested some years ago by Leblanc, but we are not aware that it has been practically developed, though recently several patents involving the principle have been issued to Mr. Charles S. Bradley. The details of auto-transformer connection with machine and condenser, in the article of last week, appear to constitute an improvement over the Leblanc fundamental arrangement. There can be no doubt that if alternators could be constructed as cheaply and conveniently in the asynchronous as in the synchronous type, there would be simplicity of parallel operation in favor of the former, since no particular skill would be required to throw two generators or motors in parallel. Considerable care is required in connecting two large synchronous machines together, so as not to throw them out of step.

MANHATTAN ELEVATED APPARATUS.

In connection with our recent discussion of experiences on the Manhattan Elevated road since electric traction was adopted there, we published last week, as our readers will have noted, a very interesting and able letter from Mr. Stillwell, written in general defence of the management, and advancing some figures as to the remarkable traffic done on the road, in spite of all drawbacks and delays, since the electric service went into operation. There is no denying the fact that Mr. Stillwell makes out a good case, even while admitting the slackness or want of foresight that permitted the road to get stalled in such a terrible and punishing manner. The management of the elevated is charged at all times with a very grave responsibility, and in view of the direct and intense suffering that can be inflicted on the community, the duty to the public cannot be discharged with too keen and sensitive a conscience.

The main item in this discussion, for us, however, is the relief of the electrical apparatus concerned, from the obloquy and doubt cast upon it during the recent unfortunate episodes. As we said before, it is not our wont to rail at corporations, but rather to justify them if the facts warrant. In this instance the harm done to the electrical cause was deep and serious, and there was nothing left for us but to rise in protest. Not only have we heard scores of New York professional and business men criticize the system, but we happen to know that deprecatory accounts were cabled abroad, likely, and possibly calculated, to do costly injury to electric traction as an industry. We suppose that every piece of electrical apparatus made is susceptible of higher perfection than is now afforded, but it must be a matter of common observation to every one of our readers living in New York or visiting the city, that the electrical apparatus has operated most admirably, affording intrinsically greater pleasure and comfort to elevated road passengers than they have known in a decade. Generators, motors, controllers, multiple unit details, fuses, lights and heaters have all functioned excellently well, and any one who affirms to the contrary has either misunderstood the situation or has been misinformed. There have been one or two curious stories of mishap in the newspapers, but they have had an obvious explanation as to the trouble for all familiar with the mechanism, and in no case has the electrical apparatus been at fault. We have heard some complaint of the "jerk" on the Sixth Avenue trains, due to assumed faulty acceleration or sharp arrest. But those who have traveled on the Third line and, better yet, the Second Avenue, know that the personal equation cuts a considerable figure, and that when once the knack of handling the control system is learned, the smoothness of motion obtained is most agreeable. At the worst, the fact that by means of the control system the time of an ordinary trip of forty or forty-five minutes can have a quarter of an hour saved on it, would condone a much acuter jerking than anything we have, ourselves, felt from inexperienced motormen. Besides, there is for the road the economy of one man, and the system is absolutely automatic in throwing off current at critical moments, should such occur.

We are constrained to make these few remarks not only because of the palpable injustice done electricity in the incident, but because at no distant date another great electrical equipment will be working for transportation purposes in the Subway. The public need have no fear about electricity there, provided it be given a fair show and fair play, as in other notable spheres of action where it has demonstrated its splendid utility, availability, flexibility and safety. After all, the complaints against electricity simmer down to such trivialities that even our passing discussion treats them above their real merit. The electrical multiple unit system has not been the direct or indirect cause of any accident or delay. It is a complete and undeniable success, and vindicates the judgment of engineers like Mr. Stillwell, who staked a high professional reputation on its adoption, as against the locomotive method. There is absolutely no warrant for the idea that parts of the contacts have stuck through fusing or freezing, so that the current could not be shut off; and the experiences we have quoted from Chicago, Boston and the Albany & Hudson show that the third rail is even at this early stage a feasible, workable contact device of very wide application.

Telegraph Lines Along Railroads.

Judge Kirkpatrick in the United States Circuit Court for the District of New Jersey, has handed down a decision making permanent the injunction restraining the Pennsylvania Railroad from interfering with the lines of the Western Union along the Pennsylvania right of way. He said:

"Two suits have been brought in this court, the one at law to condemn lands of the defendant company sufficient for the construction, maintenance and operation of the telegraph lines of the complainant under provisions of the act of 1866; and the other in equity to restrain the defendant from interfering with the telegraph lines of complainant now erected upon and along defendant's right of way until the question of the complainant's right to condemn the said lands upon the payment of compensation has been determined by the court. It appears by the record that the complainant company has maintained its telegraph poles and lines upon the right of way used by the defendant for more than 40 years, and that on September 20, 1881, an agreement was entered into between the complainant and defendant companies for twenty years for the rent therein reserved, by which the defendant granted complainant a right to place, maintain and use upon the right of way of the Pennsylvania Railroad Company and the roads owned, operated or leased by a single line of telegraph poles, and to maintain thereon such wires as the telegraph company might from time to time elect.

"The agreement also contained a provision that if no new agreement were made the telegraph company should, at the termination of the contract, or at any time thereafter, upon receiving written notice from the railroad company, remove within six months its poles and wires, and leave the property of the railroad in good condition and free from encumberance; and if not so removed, the railroad company was to have the privilege to remove them at the expense of the telegraph company. In accordance with this provision the railroad company on May 15 gave notice to the telegraph company that it must remove its poles and wires on or before December 1.

"The bill recites that the wires strung on the defendant's right of way are part of a main trunk line used in the interchange of communication between people dwelling in different States of the Union; that their destruction would seriously interfere with such communication; that the lines have been erected at great cost, and that their worth in the present condition is in the neighborhood of $350,000; and that if the wires should be removed from the poles and the poles cut down, their value would be less than $50,000. Upon this statement of facts the complainant asked that the defendant company be restrained from removing its poles and wires until the right of condemnation could be heard and determined and the court granted a rule to show cause why such preliminary injunction should not issue according to the prayer of the said bill, which said rule now comes to be heard.

"Upon the case now presented, Congress in 1866 enacted that any telegraph company shall have the right to construct, maintain and operate telegraph lines over and along any of the military or post roads of the United States, but such lines of telegraph shall be so constructed and maintained as not to interfere with the ordinary travel on such roads. That act provided that any telegraph company before exercising the powers or privileges conferred by the act should file with the Postmaster General its written acceptance of the restrictions and obligations required by the act. This act, the bill alleges, was accepted by the complainant company, which has conducted its business in accordance therewith. All railroads of the United States are by law declared to be post roads (revised statute) and the right of way of the defendant companies thereby becomes subject to the provisions of the act of 1866.

"The latter question has not received judicial interpretation by the court of last resort, but the statute of July, 1866, as applicable to post roads, has several times been before the courts for their construction. It has been held that because of this law one company having exclusive privileges under the State law cannot prohibit the erection of the telegraph lines of another company on the post roads of the United States, where such other companies have accepted the provisions of the act of 1866, when those in control of such roads had given their assent. It has been decided that no railroad company owning a post road of the United States, over which interstate commerce is carried on, can bind itself by agreement to exclude from its roadway any telegraph company, incorporated under the law of a State, which accepts the provision of the act and does not interfere with the ordinary travel of the road.

"If a State cannot, by legislative enactment, prohibit a foreign corporation which had complied with the act from erecting its poles and wires over a post road belonging to a railroad company which has given its assent thereto; and if a railroad company cannot by agreement with one telegraph company bind itself to exclude another telegraph company from the use of its right of way because it is a post road, how can a railroad company (being a post road) nullify the act by arbitrarily refusing to grant them a right which the law confers? Surely if the railroad company cannot bind itself by agreement to exclude the telegraph company it cannot do so arbitrarily.

"If the act gave a telegraph company the right to erect its poles upon post roads, it prohibited the owners of such roads from doing anything which might be hostile to the object contemplated by Congress and render its acts ineffectual. The suit of Postal Telegraph against Oregon Short Line to condemn a right of way has been passed upon by the court of last resort and is therefore binding upon this court. The decision held that the right of condemnation existed and the court proceeded to assess damages.

"Enough has been said to show that the contention of the complainant of its right to condemn is not without force. The only question now before the court upon the return of this rule is whether the defendant shall be enjoined, pending the determination of the complainant's right to condemn, from interfering with the status quo and doing to the complainant an injury which may be irreparable. It is not necessary that the court should determine that the complainant is entitled to a final award in its favor; it is enough that the case presented seems sufficiently meritorious to warrant the court in preserving the status quo until the real merits of the controversy have been finally determined.

"To grant the injunction asked for in this case would result in irreparable injury to no one, while the refusal to do so, from which there would be no appeal, would result in the destruction of complainant's property, for which they would receive no compensation.

"If the right of condemnation exists, complainants should not be subjected to that loss while exercising it. The defendants say they have entered into a new contract with another telegraph company, and that there is not sufficient room on their right of way to permit of the maintenance and operation of the lines of more than one telegraph company. This question ought, I think, for the reasons above given, to await the final determination of the court. To compel the complainant to vacate the premises would entail a great destruction in value of property, without compensatory benefit to any one.

"In view of the facts presented, and for the reasons above stated, I have decided to make permanent this injunction. In this way the defendants will have an opportunity to appeal to the next term of the Circuit Court of Appeals; while should the rule be discharged the complainant would have no appeal and the injury to its property would have been accomplished before the case had been properly considered."

As an offset to this decision, Judge Buffington, in the United States Circuit Court at Pittsburg, has handed down a decision refusing to grant the Western Union petition for condemnation proceedings to condemn a right of way along the lines of the Pennsylvania Railroad. The Kirkpatrick decision is to be appealed at once.

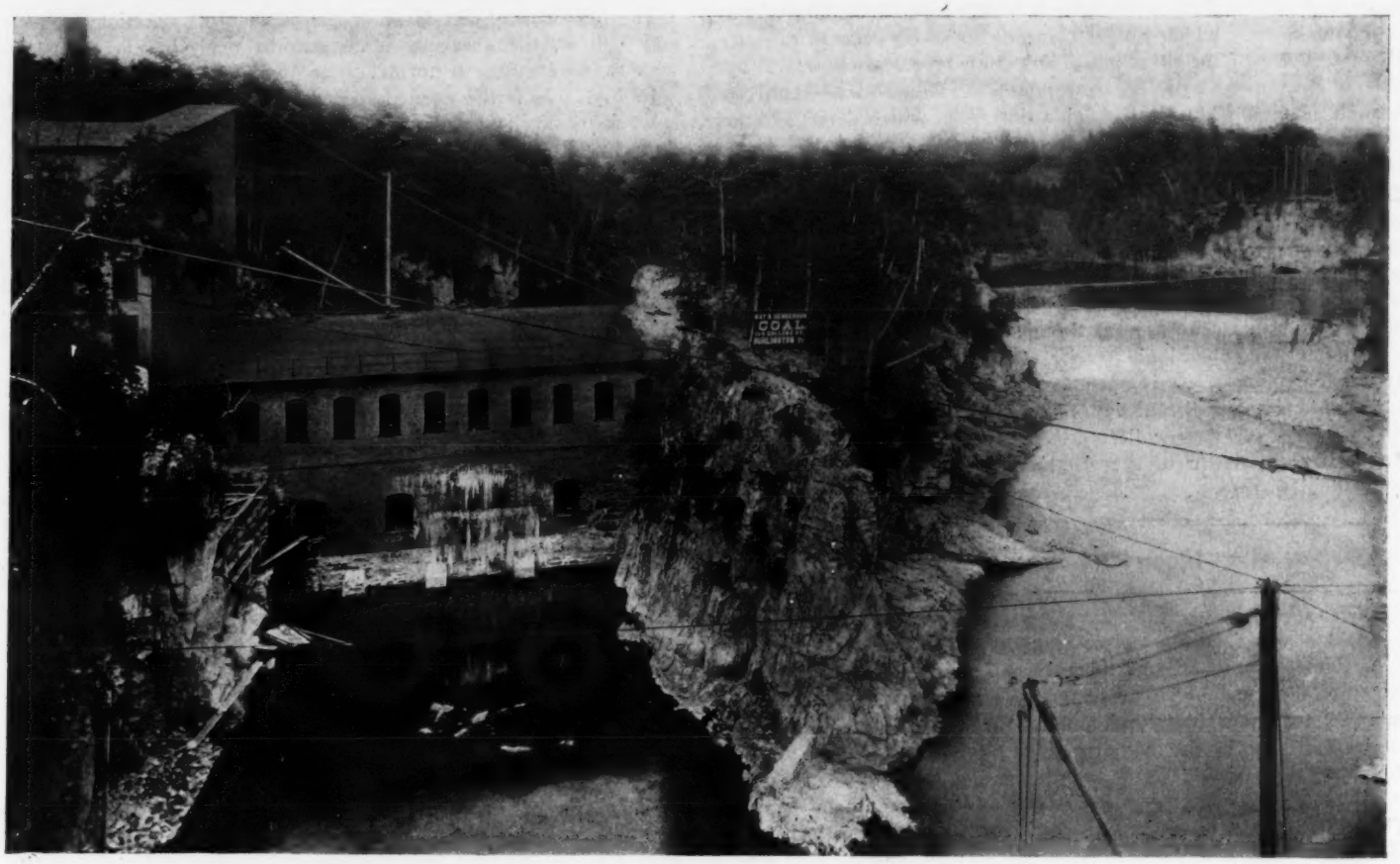
Municipal Ownership and Public Franchises.

Under the auspices of the Committee on City Affairs of the Reform Club of New York City, the convention on municipal ownership and public franchises will be held at the rooms of the club on Fifth Avenue on a Thursday and Friday toward the end of February. The exact date cannot be fixed until word is received from English administrators who have been invited to attend. Addresses are already promised by Mr. Robert P. Porter on "The Recent History of Municipalization in Europe"; by the staff of the School of Commerce of New York on "The Recent History of the Municipalization in the States"; by Frederick Howe, of Cleveland, on "Taxation of Franchise Values," and by Lieutenant James B. Cahoon on "Municipal Ownership of Gas and Electric Lighting Plants." A number of other addresses will be announced later.

Water Power on the Winooski.

BY ALTON D. ADAMS.

IT is a rugged spot. During uncounted ages the soft hand of the Winooski, armed with cutting points of sand and gravel, has gradually carved a narrow gorge 100 feet deep in the solid rock that forms its bed. In the center of this gorge is a great monolith that divides the waters. A few rods below this monument to the untrained forces of nature is a narrow, single-track railway bridge, over which express trains pass to and from Burlington, Vt. If a train ever goes through that slender trestle—well, the water 100 feet below is shallow, but the bottom is hard. Some ten years ago Dr. W. S. Vincent, the pioneer in electrical enterprises at Burlington, Vt., saw the value of this site for a power station and secured the entire water privilege. The foresight required for this move at a time when electrical supply from water power was a thing of questionable expediency has recently had a full reward, for Dr. Vincent has sold the entire holdings of his company to capitalists of Philadelphia at a handsome advance on their original cost. Meantime the late Vermont election has made Dr. Vincent a member of the State Legislature, and, having demonstrated the value of water, it is now thought that the Doctor will help residents of the Green Mountain State to the benefits of a stronger liquid, and thus fill a long-felt and depressing want.



GENERAL VIEW OF WATER POWER ELECTRIC PLANT AT BURLINGTON, VT.

An electric power station across a river, in a river, and, if the sensations produced by a descent to the wheel level are to be believed, under a river. This is the situation in which electric power is generated for the city of Burlington. The structure which occupies the entire cross section of the gorge between one main bank and the rocky island is at once a dam and a power station. Rising from bedrock in the river, 110 feet long between the banks, and 60 feet wide, the station forms a rigid mass of masonry. The wall on the upstream side of the station takes the pressure of 33 feet of water, and this water after flowing through the station by way of the wheels flows out on the down-stream side.

Across that half of the river not occupied by the power station there is a timber crib dam filled with stone and based on solid rock. This crib dam is 100 feet long and 25 feet high. The water power afforded by these structures has been in use during ten years to operate the entire light and power system of the Vermont Electric Company, and in all this time steam has been used only two days because of lack of water. The dam and power house set the river water back three miles, thus giving fair storage capacity. At times of moderate flow there is 2,500 hp available in the electric station. This water power and the electric station are about three miles from the business center of Burlington, and in view of future extensions the company has recently acquired another water power of about equal capacity a few miles further upstream on the Winooski. At the electric station the full head of water is 31 feet, and it is utilized by four horizontal turbine wheels having an aggregate capacity of 2,200 hp at 130 r.p.m. Three of the wheels are of the Hunt make, one being rated at 350 and two at 635 hp each. The fourth wheel is of the Hercules pattern and is rated at 680 hp. All the turbines are located on the lower floor of the station and are connected by belts and clutch pulleys with the main shaft on the upper floor. This shaft is 7 inches in diameter, 110 feet long and extends the entire length of the station, operating at 225 r.p.m. Regulation for constant speed is had with a Lombard and a Schenck water wheel governor. At one end of this shaft and directly mounted on it by clutch is a 500-kw General Electric three-phase generator of 32 poles, which operates at 225 r.p.m., 60 cycles and 2,300 volts. At the other extreme end of this shaft is direct-coupled by clutch a McIntosh & Seymour, single-cylinder engine, rated at 500 hp, with 100 pounds steam pressure. The remaining dynamos are connected at intervals along the shaft by belts and clutches. Two of these dynamos are of Westinghouse make, each having a capacity of about 200 kw, and operating at 2,300 volts, 60 cycles and 450 r.p.m. These Westinghouse dynamos are three-phase and have 16 poles each. The remaining dynamo equipment is made up of six series arc machines with an aggregate capacity of 360 2,000-cp arc lamps. Five of these arc dynamos are of the Brush make, four having a capacity of 65 lamps each, and one of 45 lamps. The remaining arc dynamo is a 55-lighter of the Thomson-Houston make.

On the river bank adjoining the water power station is an extension which contains the boiler plant and also storage, supply and repair rooms. Four horizontal return tubular boilers rated at 150 hp each, with 100 pounds gauge pressure, make up the plant. These boilers and the engine above mentioned are retained simply for use in case of accident to the water power equipment, as the flow

of water is ample to carry the load at all times of year. Service from the station is continued during the entire 24 hours daily, it being the practice to disconnect any one of the water wheels or dynamos from the main shaft by means of the clutches when they are not required. This electric plant is about one-half mile from the public highway leading to Burlington and the pole line between the plant and the highway passes over a private way. All of the electric light and power service in Burlington is derived from this water power plant and the distribution lines are all run directly therefrom. Besides the series arc circuits, the pole line from the water power plant to the business center of Burlington carries nine No. 0 wires for the alternating service. These nine wires form three three-phase circuits. One of these circuits is devoted exclusively to the supply of induction motors and the other two circuits to commercial lighting. All three circuits operate at 2,300 volts.

As may be seen from the foregoing, no sub-station is employed at Burlington. The lighting load of the system includes about 200 street and 40 commercial arcs all of 2,000 nominal candle-power. Commercial lighting includes about 15,000 incandescent lamps. Owing to the moderate rates at which electric power is sold, the motor load of the Burlington system is relatively large, aggregating 550 hp in motors, which range from one to 50 hp each in capacity. All motors are of the three-phase induction type and operate at 220 volts. Nearly all of the incandescent lamps are connected through meters. The Philadelphia interests which have recently acquired the electric system at Burlington are also owners of the gas plant there, so that the two are operated in harmony.

Burlington, the largest city in Vermont, should be especially interesting to electrical interests. The new water power to be developed higher up on the Winooski will ultimately involve a large amount of electrical equipment. In contrast with general electrical supply, the street railway facilities of the city are in a comparatively undeveloped state. At present the electric railway is of only moderate extent, mostly single track, and its equipment from power station to rolling stock is such as will require extensive renewals and additions at no distant day.

These facts have been collected through the courtesy of Dr. Walter S. Vincent, the nestor of the electric lighting and telephone service in Burlington.

Electricity on Canals.

Governor Odell, of New York State, in his annual message to the State Legislature, discussing plans for improving the Erie Canal, says: "Suggestions have been made, and it is only fair that they should be presented to you, that if the canal were enlarged to a nine-foot level and by the use of the water powers of the State and by the introduction of electric motors that not only the same object could be accomplished, but that sufficient revenue could be derived from the sale of power to almost maintain the canal. The cost of electric equipment and providing water power would be much less than under the thousand-ton plan, and perhaps would accomplish the same results If this be feasible I am sure that all who are interested in the welfare of the canals would be glad to give it consideration. If this plan should be adopted, the canal could be constructed within two or three years and the constant withdrawal of commerce could be checked much more rapidly than under the thousand-ton barge plan, and it could be provided for under the present constitution. The former would require an amendment." The Governor has recommended the abolition of the State tax on franchises granted to corporations.

St. Louis Exposition Rules.

The rules to which exhibitors, concessionaires and state and foreign governments must conform in the erection and maintenance of structures on the St. Louis Exposition grounds have received the final approval of all authorities concerned. The rules govern the erection of buildings and structures on the exposition grounds other than those erected by the Louisiana Purchase Exposition Company; the treatment of the grounds around buildings; sewer connections; water supply; plumbing; gas supply; fire protection by the high-pressure water system; supply of electricity; supply of steam; supply of compressed air, and the disposal of garbage.

Stress on Frames of Alternating Current Generators.

By P. J. Frenell.

EVERYONE dealing with electrical apparatus has doubtless noted that certain parts of alternating-current generators have considerable weight, especially the stationary parts of generators of the rotating field type. These are in the most cases of very heavy construction, and the amount of material actually needed to resist the external forces might be reduced in many cases to half of its actual value. This means, of course, less cost for building and for the transportation of the machine. The following investigation of this subject may be of interest to those who are not familiar with the calculation of stresses. As the theories are of a general nature they can be applied to any kind of stationary frames. That is, they can, with good judgment, be used as well for alternating as for direct-current machines.

Suppose a curved beam having an invariable cross-section is under the action of balanced forces. These forces can be divided into one force normal to the cross-section, and another in the same plane as the section, and one moment of force.

The influence of the force in the plane of the section or, as we may call it, the shearing force, can be neglected in comparison with the stress due to normal force and moment.

In Fig. 1 N is the normal force, positive when positive with respect to tension and negative with respect to compression. M is the moment of force, positive when turning clockwise and negative when turning counter-clockwise.

Let p and p' be two cross-sections of the beam infinitesimally close to another. These intersect the neutral line (the stress here is O) of the section in the points O and O'. The planes p and p' extended intersect each other at a straigght line in c. This is the central axis of the beam. r is the radius for the neutral line of section, CO and $y = OP$ is the distance from the neutral line to the points P and P'.

Under the influence of the normal force N (positive), the beam is deformed as follows: The plane p' turns relative p with C as an axis to a new position p''. See the dotted narrow line in Fig. 1.

In addition to the force N is the moment of force M (positive). This acts to decrease the radius of the neutral line. Hence the new central axis for the beam is at C_1, instead of C. The final deformation is indicated by dotted lines.

The theoretically derived formula for the stress in the section is, if P = area of cross-section, and σ = stress per square inch of section,

$$\sigma = \frac{N}{P} + \frac{M}{rP} + \frac{r}{r+y} \cdot \frac{My}{\mathfrak{z}}$$

$$\text{whence} \quad \mathfrak{z} = \int r \frac{y^2}{r+y} dP$$

The value of the stress can be found for any part of the section by means of this formula, if the external force and moment, the radius of the neutral line, the area of section and the quantity I are given. This quantity I differ very little from the moment of inertia for the section. For rectangular and circular sections the difference can be calculated mathematically, and is if h = height of cross-section, I = moment of inertia less than 1.01 I for $\frac{r}{h}$ larger than 4.

Hence we can with a slight approximation introduce the moment of inertia I in the formula instead of I. The neutral line for the beam is in this case the same as the line through the centre of gravity of the section; therefore, the radius r is the radius to the centre line of gravity.

e_1 = max. distance from centre of gravity to outside fibre.

e_2 = max. distance from centre of gravity to inside fibre.

Substituting y for e_1 and e_2 in the formula we get the value of maximum fibre stress, or

$$f_s = \frac{N}{P} + \frac{M}{rP} + \frac{r}{r+e} \cdot \frac{Me}{I} \qquad (I)$$

This formula can be applied when figuring the stress due to weight and unbalanced magnetic pull.

For figuring the stress due to equally distributed magnetic pull, the frame is to be considered as a ring of uniform section, the problem being of the same nature as in the case of a cylinder with out-

side pressure, except that instead of having a normal pressure outside we have a normal tension inside the ring.

The magnetic pull can be considered as distributed because of the large number of poles of alternators. This cannot be done, of course, in the case of direct-current generators.

Let t = tension per square inch on the inside diameter of the ring; $a = r - e_2$; $b = r + e_1$, then the formula is

$$f_t = -\frac{t\,a^2}{b^2\,a^2}\left(.4 + 1.3\,\frac{b^2}{x^2}\right)$$

Substituting for the outside fibre stress, $x = b$, and for the inside fibre stress, $x = a$, then the outside fibre stress is

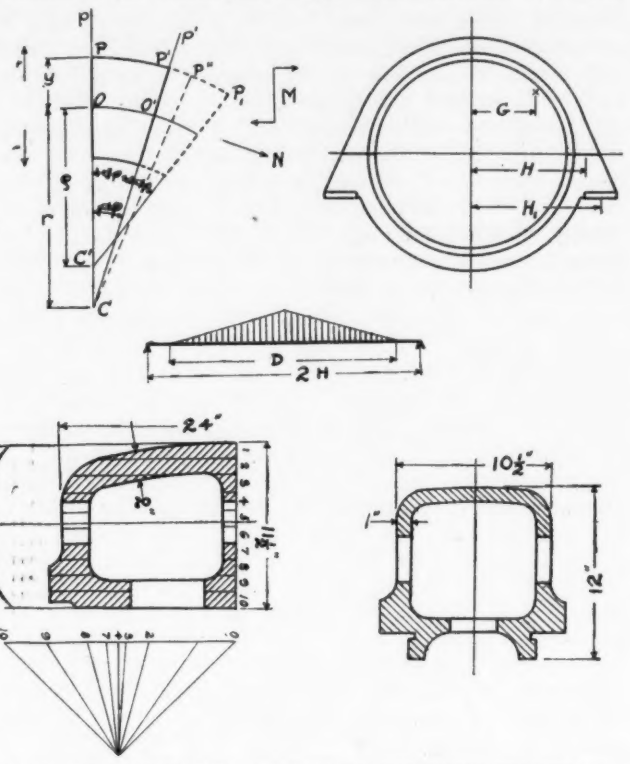
$$f_t' = -1.7\,\frac{t\,a^2}{b^2 - a^2} \qquad (2)$$

and the inside fibre stress is

$$f_t'' = -\frac{.4\,a^2 + 1.3\,b^2}{b^2 - a^2}\,t \qquad (3)$$

Since we now have all necessary formulas for our calculation, they will be applied to an actual example.

For this purpose we will select a frame for an alternating-current generator of the rotating field type. The generator is of ordinary size and appearance. The frame has a horizontal split, as shown in Fig. 2. Following are the data:



FIGS. 1 TO 5.—ILLUSTRATING STRESSES ON GENERATOR FRAMES.

Rating, 500 kw; diameter inside lamination, 84.5 inches; outside diameter of frame, 120 inches; width of lamination, 16½ inches; width of frame, 24 inches.

The cross-section of the frame is shown in Fig. 3. This figure also shows the method of finding the moment of inertia of the section and the centre of gravity. The method is well known, and does not need any explanation. The area of section multiplied by the polygon area gives the moment of inertia; and the intersection between the first and the final side in the polygon gives the position of the centre of gravity.

Area of cross-section, 95.64 square inches.
Area of polygon, 17.38 square inches.
Moment of inertia $= I = 95.64 \times 17.38 = 1662$ inches.
Max. fibre distance outside frame $= e_1 = 5.58$ inches.
Max. fibre distance inside frame $= e_2 = -5.92$. inches.
Radius of center of gravity $= r = 54.42$ inches.
Span of upper frame part $= 2H = 116$ inches (see Fig. 2).
Span of lower frame part $= 2H_1 = 136$ (see Fig. 2).

If g is the centre of gravity of one quadrant of the frame, including the weight of frame, laminations, winding, etc., the distance from g to the vertical centre line for the frame is $G = 32.1$ inches, and the same for the upper and lower quadrant.

We will first consider the stress of the upper part, due to weight of fr me, laminations, winding, etc.

Weight of frame, upper part = 6,300 pounds.
Total weight of upper part = 10,000 pounds.
Reactions at split = 5,000 pounds.
The maximum stress is, of course, at the top of the frame
Moment $M = -5{,}000\ (H - G) = 5{,}000\ (58 - 32.1)$.
$M = -129{,}500$ pound-inches.
Normal force $N = O$
Using formula (1) we get
$f_s' = -420$ pounds per square inch for outside fibre stress.
and
$f_s'' = +492$ pounds per square inch for inside fibre stress.

The stress of the upper part due to unbalanced magnetic pull, with the rotating part 1-32 inch out of centre it 7,500 pounds.

We will suppose that the rotating part is 1-32 inch out of centre in a vertical direction upward and that the total magnetic attraction between the field, and the armature is unchanged, the distribution only being different. That is to say, the increase of magnetic attraction at the upper half of the generator is equal to the decrease at the lower half. Hence the unbalanced magnetic pull is equally divided between the upper and lower part. The unbalanced magnetic pull for upper part equals 3,750 pounds.

The distribution of the pull around the frame can be figured mathematically, but as it would take considerable space and is not necessary for determining the stress, some close assumptions will be made instead. The pull is zero at the split and reaches its maximum at the top of the frame. Therefore we may consider the magnetic pull as a triangularly distributed load on the frame. This is diagrammatically shown in Fig. 5, the load being projected on the diameter of the frame.

The moment for the top section is

$$M = -\frac{3750}{2}\left(H - \frac{H}{3}\right) = -72500$$

Normal force $N = O$ (appr.)
$f_u' = -235$ pounds per square inch for outside fibre stress.
$f_u'' = +276$ pounds per square inch for inside fibre stress.

Next will be taken up the stress due to equally distributed magnetic pull. The generator has 32 poles and a magnetic pull per pole of 2,640 pounds. The total magnetic pull is 84,480 pounds, and the pressure per square inch of armature diameter $= \frac{84480}{\pi \times 184.5 \times 16.5} = 19.25$.

The laminations 16.5 inches wide, and the pressure per square inch of frame diameter is $19.25 \times \frac{84.5}{97} = 16.8$.

Using formulas (2) and (3) we get
$f_t' = -54$ pounds per square inch for outside fibre stress.
$f_t'' = -75$ pounds per square inch for inside fibre stress.

The total fibre stress for the upper part of the frame for the top section is
$f' = -709$ pounds per square inch for outside fibre stress.
$f'' = +692$ pounds per square inch for inside fibre stress.
Outside there is compression, inside tension.

The total weight of the lower frame part is 11,620 pounds, and the total stress is
$f' = +1{,}087$ pounds per square inch outside fibre stress.
$f'' = -1{,}413$ pounds per square inch inside fibre stress.
The outside is under tension and the inside under compression.

It is apparent that there is considerable waste of material in this frame. For comparison is given the stress of another frame of which the section is shown in Fig. 4

Rating, 300 kw, 36 poles; diameter inside lamination, 87 inches; outside diameter of frame, 117 inches; area of section, 36.38 square inches; moment of inertia, 612 inches.

Unbalanced magnetic pull, 4,500 pounds total; balanced pull, 1,500 pounds per pole.

$2H = 2H_1 = 105$ inches. $G = 31.8$
$e_1 = 6.35$; $e_2 = 5.65$.
The weight of the upper part is 3,800 pounds, and the total stress
$f = -875$ pounds per square inch outside.
$f = +703$ pounds per square inch inside.
The weight of the lower part is 4,200 pounds and the total stress
$f = +771$ pounds per square inch for outside fibre.
$f = -951$ pounds per square inch for inside fibre.

The stress is very low, even in this frame, but it is better designed, because we have approximately the same stress in the upper and lower frame parts.

The Evolution of the Modern Telephone System.

By L. A. Lindsey.

TELEPHONE systems, although of comparatively recent origin, have been the subject of numerous patents and designs, each system having some feature or features different from any other. As a consequence, at this stage of their development, we rarely find two large exchanges constructed in exactly the same manner, something being learned from each installation that causes the next to be changed in some particular detail.

The prime idea in a telephone switchboard, which is essentially the greater part of the system being to connect and disconnect any one line with any other line at will in as short a time and at as small an expense as possible, many devices have been used to accomplish this end, each sacrificing, one or the other or both, the time and expense element to a certain extent, in order to reach some particular end or to avoid some particular obstacle. Some engineers have used electro-mechanical apparatus, and while the remarkable simplicity on the part of the subscriber by which any desired number may be called, incident to the best of these systems, is a great tribute to their skill, they have yet problems to solve before the automatic exchange can displace the "Hello Girl." Although some of the automatic systems give excellent service in places suited to their respective capacities, they still lack some of the good features that demand the human element at the central office; and while subscribers using the best of these make their own "busy" test, do their own connecting and ringing, and have no operator to complain to of slowness of service, to ask the time of day, or to bother with numerous other questions which the shrewd operator soon learns to answer with an assumed air of pleasure, the great majority of systems use the familiar "Central Operator," who is supposed to be always ready to comply with the wishes of the subscribers by giving the location of fires, the results of elections and to act as a general "Bureau of Information."

The manual systems necessarily divide themselves into two distinct classes—the trunking or transfer system as it is sometimes called, and the multiple system. Either of these may be used in connection with the magneto type, local battery or common battery system of transmission, or with the various combinations of these.

The object in any system is to provide means by which the subscriber may call the attention of the operator, inform her of the number wanted and give her some means of knowing when the conversation has ended, and whether another connection is wanted or the line is to be left idle, and the degree of success attained by any system is measured by the simplicity and ease with which these functions are performed.

The means employed to get the attention of the operator have been (*a*) the call wire, with which it is necessary for the subscriber to operate a switch which will connect his talking circuit with that of the operator; (*b*) the magneto system, with which it is necessary to operate a small generator supplied at each station, which is connected to some electro-magnetic device, usually a drop, or with a relay in connection with a miniature incandescent lamp or small secondary electro-mechanical device which may be placed directly in front of the operator, thereby economizing switchboard space, which will be seen to be very valuable in large switchboards; (*c*) the automatic signalling systems, with which it is only necessary to lift the receiver from its support, which operates a switch allowing the current to flow through the drop or relay at the central office, thereby actuating the lamp or other secondary device. In connection with these secondary signals in which the primary part of the signal is not within reach of the operator, it becomes necessary to restore this to its normal condition or disconnect it temporarily from the line.

In magneto systems the called subscribers' bell is usually rung by the calling subscriber, but in other systems it is rung by the operator, who has one or more ringing keys connected to each pair of cords, these keys being connected to a small alternating-current generator. In such cases it becomes necessary for the operator to know when the called subscriber answers, and the apparatus which gives the operator this information also serves to indicate the fact when the conversation has ended. This signal is known as the clearing-out or disconnect signal, and is very similarly transmitted to the calling signal; that is, by speaking over the call wire, ringing the magneto, or replacing the receiver.

Returning to our subdivision into trunking and multiple systems, in the transfer system it is necessary for an operator receiving a call to transfer it to the trunking or "B" operator handling the called number unless this number happens to be within reach of the operator receiving the call, known as the "A" operator. It is evident that this requires an average of nearly twice the time required if the "A" operator could, in all cases, reach the called number. These trunking operators are placed at every third operator's position throughout the entire board and have a number of trunks to each "A" operator's position which she can connect with any line coming into one "A" operator's position on either side of hers; thus any number may be connected to any other number. Two great disadvantages in this system are the necessarily slow service and the employment of fifty per cent. more operators and a larger switchboard than would be required could the "A" operators reach any number in the system. The limit to the number of subscribers that can be handled in one of these boards is reached when the "B" operators have no more room within their reach for trunks, though I have never heard of this limit being reached.

In the multiple system every number is multiplied or multipled so that one terminal of the line comes within reach of each operator. We can, therefore, dispense with the "B" operators, except in case of two or more exchanges in one system, in which event the "B" operators handle the business between different exchanges in a very similar manner to which the "B" operators handle it between different "A" operators' positions in the trunking system. The trunking business is divided into outgoing and incoming; that is, all calls originating in an exchange are known as outgoing at that exchange and as incoming at the exchange in which the called subscriber's line is located. The outgoing trunks are multipled throughout the board, while the other end of these same trunks, known as incoming, terminate in plugs at the "B" operator's position at the second exchange. She can thus reach any subscriber in that exchange by inserting these plugs into the corresponding multiple jack.

It is in this way that any one of the seventy-five thousand subscribers in New York City and its immediate vicinity can be connected with any other in less than ten seconds. In any one of these exchanges the greater part of the business will be handled wholly within this exchange, since the exchange will necessarily contain all the telephones in this portion of the city, and by being handled by the operator receiving the call, the time and expense is reduced to a minimum, and it takes no longer for a subscriber in one exchange to reach a subscriber in another than it takes to reach a subscriber in the same exchange using the trunking system. The number of subscribers that can be handled in an exchange of this kind is limited to the number of multiple jacks that can be placed within reach of an operator, which, with the most favorable conditions, is not less than twenty-four thousand; and this is one of a number of units composing a system, so it is difficult to imagine the exact limit in numbers of subscribers that can be successfully handled in one system of this kind.

It is evident from the foregoing that the multiple system is the ideal one for exchanges having more than a few hundred subscribers, and we will now consider the different methods of the transmission of speech. Since the magneto transmitter which was first used gives such inferior results as compared to the battery transmitters, the only types we have to consider are the local battery, in which a battery of one or more cells is placed at each telephone, and the common battery, in which the battery consists of a number of cells at the central office which are common to all telephones, hence the name. In the local battery system, since the work required of the battery is intermittent and during only a small per cent. of the time, the batteries used are, with very few exceptions, of the open-circuit type; unfortunately, there is not yet a battery of this class known that will not polarize in a short time, which means that it has temporarily exhausted itself and must rest for awhile before it is as efficient as it was at the beginning of its work. This answers very well for telephones that are not used many times each day, but evidently serves a poor purpose where the telephone is used almost continually, as is the case with those in large business houses. Besides this disadvantage, it requires a great deal of time and expense to visit periodically the stations and replenish the parts of the batteries as necessity demands, in addition to the liability of the jars getting broken and spilling the solution of walls, floors, etc., the solution used in some cells being very destructive.

The common battery system, while possessing none of these disadvantages, is more economical to install, and can be kept in condition at a very small expense compared to the numerous batteries

used in the other system; and since current from storage batteries is cheaper than current from any kind of primary batteries, lamps may be used for signals which operate noiselessly and occupy a small amount of switchboard space. Another point in its favor is its ready adaptation to automatic signalling, as all signals can be transmitted by simply removing the receiver from its support or replacing it.

Taking all the above in consideration, the common battery, lamp signal, multiple system is evidently best suited for large systems, in which conclusion experience bears us out; and the different detailed constructions of these are more or less perfect inasmuch as they perform the required duties with simple, durable and inexpensive apparatus.

Results With the Third Rail in Boston.

Since June 16, 1901, the date of starting, the elevated tracks of the Boston Elevated Railway have been in continuous operation without material interruption. The total length of the elevated railway line is 6.644 miles and the length of second main track 6.468 miles, making the entire length of main track 13.112 miles, to which must be added 2.431 miles of sidings and switches, so that the elevated structure carries 15,543 miles of track. Over this entire length of track cars are operated exclusively from a third rail mounted at one side of the traction rails. The famous Boston subway, owned by the city but leased and operated by the railway company, connects two points on the elevated structure, one being at the North Union Station and the other at Pleasant Street. The length of this subway connection is only 1.201 miles, but it has proved to be an element of some trouble in the operation of the system owing to its curves and grades. At this point it may be stated that the cars which operate on the elevated tracks and on their connecting link through the subway never pass to the surface tracks, but simply swing back and forth between Sullivan Square at one end of the elevated structure and Dudley Street at the other end, or else cover a part of this run and also that part of the elevated track known as the Atlantic Avenue loop. The round trip between Sullivan Square and Dudley Street, which includes a passage through the subway in each direction, represents a run of 10.077 miles. The sum of curves made on this round trip run amounts to 9.43 complete circles. The Atlantic Avenue loop represents 3.96 complete circles per round trip, making the complete number in the system over which the elevated cars pass 13.39. On the combined elevated and subway system used by the elevated cars there are ten grades of 5 per cent. each, and the subway contains one grade of 8 per cent. Over the system thus outlined trains of three cars each are operated during the greater part of each day, and trains of four cars each during rush hours. Each car is equipped with two motors of 150 hp each, giving a motor capacity of 900 hp on three-car trains and 1,200 hp on four-car trains. Two contact shoes of cast iron carried by each car press on the top of the third rail and conduct the current for its motors. One of these contact shoes is mounted on a wooden fixture secured to each truck, and this gives rise to some delay while the fixture is being detached, when it is necessary to change trucks. For this reason the fixtures carrying the contact shoes on new cars will probably be attached to the under side of the car body. Until recently the cast-iron contact shoes have been held down on the top of the third rails simply by their own weight, which is only a few pounds for each shoe. Now, however, springs have been applied to hold down many of the contact shoes, but these springs do not seem to admit of any very accurate adjustment of the pressure between shoe and rail.

As far as can be learned, there appears to be no trouble caused by any failure on the part of contact shoes to maintain good electrical connection with the rails while trains are in motion. These three and four-car trains are each operated by a single motorman located at the forward end of the first car of each train, so that electrical connections in the form of cables must pass from car to car in order to control the motors.

Owing to the grades and curves mentioned above the most frequent source of trouble in the operation of the elevated trains is the breaking of the coupling pins or links that hold the cars together. The short radii of some curves on the subway and elevated line is made apparent by the fact that it has been found necessary to give the adjustable lattice iron gates that extend from car to car at their ends a width that varies from 10 inches to 5 feet 10 inches in extreme positions. The perfection of control exercised by the motorman over all the cars of a train is well illustrated by the fact that frequently when the mechanical coupling between two cars of a train parts, the train will continue its run past several stations, including as many stops and starts, without breaking the electrical cables that pass from car to car, and even before it is discovered that the train is mechanically in two parts.

The absence of any serious trouble from short circuits between the third and traction rails on the elevated structure and in the

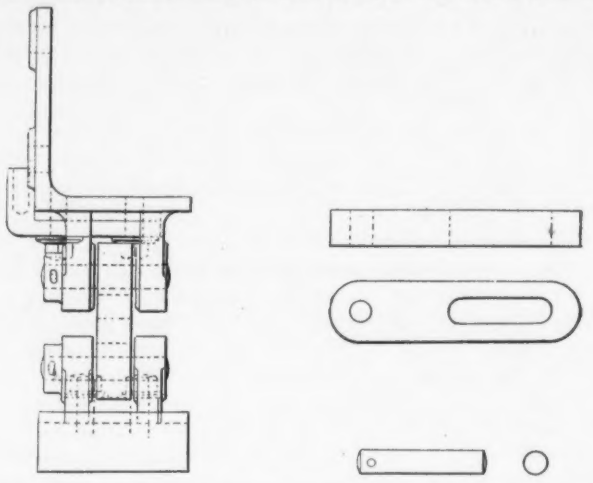


FIG. 1.—END ELEVATION OF CONTACT SHOE, LINK AND PINS.

subway seems to be due in large measure to the fact that the third rail is used mainly as a trolley wire rather than as a feeder. In other words, the third rail is divided into sections of moderate length and several independent feeders are laid to each section from the power station. If a heavy short circuit occurs at any point between the third and traction rails, the circuit-breaker of the nearest feeder connecting with that section of the third rail opens. This increases the resistance through which current passing to the short circuit must flow and thus tends to reduce that current. If the short circuit has so low a resistance that the other feeders connected to that particular section of third rail are in turn over-

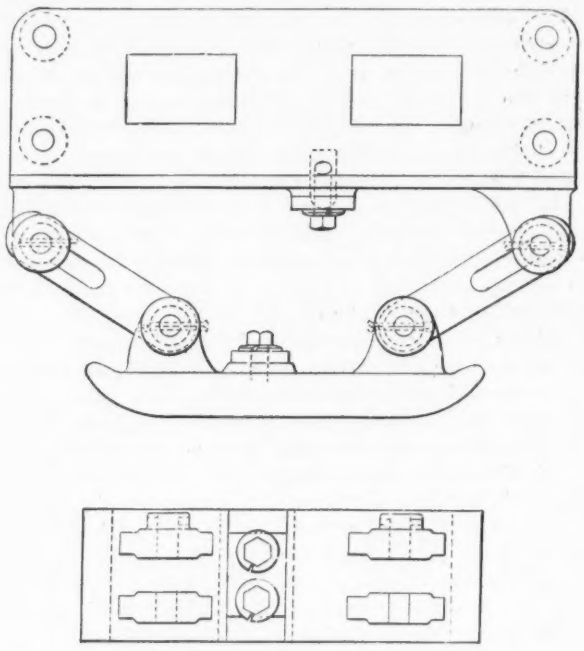


FIG. 2.—SIDE ELEVATION AND PLAN OF CONTACT SHOE.

loaded, their circuit-breakers also act and the section is entirely disconnected from the generating machinery. Owing to the use of the third rail for contact purposes merely, its weight and resistance as a conductor are of minor importance, and a light rail only is necessary. The matter of rails divided into sections, each of which thus has its own feeders, has the further advantage that when repairs of any sort on the third rail are necessary the section involved may be quickly disconnected from and reconnected with the source of power. In the nineteen months during which the third rail has been in use only two persons have lost their lives by

contact with it, each of these persons being employed by the railway, and both of these deaths occurred during the first month of operation.

The third rail is mounted in an upright position at one side of the traction rails and at an elevation suitable for contact with the cast-iron shoes on the cars. Each shoe is so mounted on its wooden fixture that it has some vertical motion to correspond with changes in the relative elevation of the third rail and the traction rails. Electrical connection between the cast-iron shoe and the wires on the car that extend to the controllers and motors is made by means of a short flexible cable, and this cable has been found to be much subject to breakage. As all of the third rail is either in the subway or on the elevated structure, it is a comparatively easy matter to keep it free from snow, and no snow storm thus far has interrupted travel on the elevated system, though surface lines have had a hard time in several instances. The only weather conditions which has thus far appeared as a serious menace to operation by the third rail is that of sleet storms or of rain that freezes as it falls. Storms of this sort cover the top of the third rail with a thin coating of ice that is very hard to remove. Any sharp instrument mounted on a car so as to come in contact with the third rail has its edge quickly destroyed and simply slips over the surface of the layer of ice without cutting through it. Thus far the best results in the removal of a thin layer of ice on the contact surface of the third rail have been reached with stiff brushes of flat steel wire, one such brush being set in front of each cast-iron shoe. While operation by the third rail has not been interrupted by these formations of ice on its surface, it is not certain that the steel brushes as now developed can keep the contact surface clean with such storms as might occur.

In the subway the third rail is mounted simply on wooden blocks, which are not, of course, exposed to storms or water. On the elevated structure the third rail has been generally mounted in iron chairs, which are attached to the wooden ties. Each of these chairs is made of two iron castings, one of which fits over the other with a layer of insulating material between them. From the edge of one casting to the other over the exposed surface of the insulating material is only a fraction of an inch, and the layer of moisture which forms in wet weather on this short, exposed surface of insulation forms a path through which the operating pressure of 500 to 600 volts forces enough current to set up an arc and destroy the insulation of the chair. This burning-out process goes on gradually and a chair may sometimes be seen smoking for several hours on a wet day before the insulation is entirely broken down. Current from the third rail passes over the wet surface of the wooden ties to the traction rails and steel structure as soon as the insulation of a chair is destroyed. Because of the defects thus developed in the cast-iron chairs it seems desirable to replace them by others in which the path of leakage over the wet surface of insulation will be much longer. In one of the designs under consideration for this purpose the main body of the chair consists of a solid cylinder of made granite approximately five inches in diameter by six inches high. An iron casting secured at one end of this granite block is intended to receive and hold the third rail.

The problem of effective insulation for the third rail seems to be in large measure one of isolation, whereby the path for leakage over the wet surface of insulating material should be made as long as possible, and the third rail removed as far as possible from the traction rails and the steel structure. It is not necessary to maintain a very high ohmic resistance between the third rail and the traction rails and earth, but it is highly important that a moderate resistance in this position shall be of a character that cannot be broken down by leakage of current. This experience of one and one-half years in the hard climate of Boston goes far to demonstrate the absolute reliability of third-rail electric traction in all sorts of weather.

Power on the Chicago Drainage Canal.

President Smyth, of the Chicago Sanitary District Board, in an article in the *Chicago Tribune* of January 11, states that there will be available along the river between Lockport and Ottawa 150,000 hp for turning turbine wheels to generate electricity. At Lockport there may be developed about 22,000 hp and at Joliet 12,000 hp. This water power along the Illinois River valley is of course the result of the opening of the Chicago Drainage Canal. The only actual utilization of the power at present has been made at Joliet.

The Underground System of the Chicago Edison and Commonwealth Electric Companies.

W. G. Carlton, assistant to the chief operating engineer of the Chicago Edison Company, read an interesting paper on the above subject before the Chicago Electrical Association the evening of January 16, 1903. The following is an abstract of the paper, which was illustrated by lantern slides:

Service is furnished by these companies at 115 or 230 volts on a direct current, three-wire system and also on the 60-cycle single or three-phase alternating system at the same voltages. These two classes include about 85 per cent. of the total business of the two companies. A considerable part of the direct current is distributed from rotary converter sub-stations fed through 9,000-volt, 25-cycle lines. These 9,000-volt lines are all underground. Until 1895 all of the low-tension direct-current lines of the company were of Edison tube. Since that time lead-covered cables have been used for feeders and in many cases also for mains. Illustrations were given showing sections of the feeder and main tubes. These tubes come in 20-ft. lengths and consist of iron pipes containing three copper rods. These rods are wound with a rope on a coarse spiral and the bunch of three is also wound with a rope. The rope acts as a separator. The tube is then filled with asphalt. The ends are closed with hard-rubber plugs. The Edison tube is convenient to use for mains on account of the ease with which services may be installed. It is also cheaper than cable in conduit where but a single line is wanted. Some of the objections to its use are that its carrying capacity is less than that of a cable of the same cross-section, owing to the low melting point of the compound used on the tube and boxes. The life of the iron pipe is comparatively short, depending largely on the nature of the ground in which it is laid. It also usually requires longer to locate and repair tube on a tube than on a cable line. In the main tubes the three conductors are of the same size, while in the feeder tubes the neutral conductor is approximately one-third the cross-section of the others.

When cables were first installed rubber was used for installation, but for several years paper-insulated cable has been used exclusively, except for submarine work. Paper cable is cheaper than rubber and also has a greater overload capacity. The cable is laid entirely in conduit and not in the ground as is a common practice in Europe. The cables vary in size from 26,000 to 2,000,000 circular mils. The thickness of insulation on low-tension cables is regulated by mechanical reasons, while on high-tension cables, the thickness of the paper wall is determined by the voltage to be used. A low-tension feeder cable as installed would, if the ends were satisfactorily protected, operate safely at 2,000 volts. The insulation on low-tension cables is from four to six thirty-seconds of an inch thick.

Services vary in size from number six to 2,000,000 circular mils. When a large load is to be taken care of, additional services are generally installed. In the case of Marshall Field's retail store, nineteen services were required.

The total number of feeders required to take care of the entire low-tension load of the Edison Company is 175. The total cross-sections is 140,000,000 circular mils of each side of the three-wire system and 29,000,000 circular mils on the neutral. The 25-cycle, 9,000-volt, three-phase lines are all run in three conductor cables. Most cables simply feed a single sub-station, while others are looped into two or more sub-stations. As the single cable may carry as much as 3,000 kw, it is necessary to take all means possible to install it in a safe manner. Where cables pass through manholes, they are covered with two layers of heavy asbestos paper and this is wrapped with brass tape .025 inches thick and 1 inch wide. This is to protect the cables from fire caused by short circuits on other cables or by gas. The more important sub-stations are fed by two or more lines.

Joints on these cables are covered with paper tape and a lead sleeve, the sleeve being wiped to the lead sheath of the cable and filled with paraffin or an insulating compound called "minerallac." The making of one joint including the fire-proofing of the cable costs from $10 to $15. As soon as cables are put in the ends are sealed to keep out moisture, but the making of the joint requires several hours and during that time more or less moisture is absorbed by the jute filling from the air and from the jointers' hands. This mosture is eliminated by "boiling out" as it is called. The sleeve is filled with the insulating compound heated to about 175° C., the pouring being continued and the compoupnd being allowed to overflow from the

vent until the joint is heated throughout and all moisture driven out. After the joint is cooled a final pouring is made to be sure the sleeve is full and the openings through which the pouring was done are sealed. Out of six or seven hundred joints made up in this manner in the past two years, we have had but one failure in new cable and that occurred when the line was first tested out. It was found that this trouble was started from moisture.

Specifications for the 9,000-volt cables call for 6/32-in. paper wall over each conductor and 4/32-in. over the three conductors. We have cables originally installed for 4,500 volts that have insulations 5/32 and 3/32 in. These are operating satisfactorily at 9,000 volts. After the 9,000-volt cables are installed they are tested at 18,000 voltage between conductors and 11,000 volts between conductors and ground for about ten minutes. The neutral points of machines supplying the 9,000-volt system are grounded and consequently the voltage between conductors and ground is only 58 per cent. of that between conductors. Insulation tests are made weekly with a galvanometer and show an insulation resistance of about 400 megohms per mile. These tests include the insulation of switches at each end of the lines, so it is fair to assume the insulation of the cable is considerably higher. The loop method is used for locating trouble and has been found satisfactory, the trouble being generally located to the nearest manhole.

In connection with the subject of high-tension cables it may be of interest to compare our work in Chicago with that in other cities. Of four companies in New York City, two are using 6,600 volts and two 11,000 volts. Providence is using 12,500, Buffalo 11,000, Milwaukee 13,200, and St. Paul 25,000 volts. So far as I know, St. Paul is using a higher voltage than anyone else on underground cables. Of the companies included in the above list, nearly all are using paper-insulated cable, although some have both paper and rubber. It is, I think, generally conceded that paper cable is generally more satisfactory than rubber for high voltages.

Comparing the thickness of insulation per thousand volts on the paper cables used by the different companies mentioned, we find that it ranges from 67 to 22 mils between conductors and from 57 to 19 mils between conductors and ground. The average thickness per thousand volts is 40 mils between conductors and 38 mils between conductors and ground.

For the star-connected, three-phase, four-wire, high-tension transmission, some two and four-conductor cables have been used for this work, but single-conductor has been found to be more satisfactory. Trouble with these cables is most apt to develop at the point of connection with the overhead lines, and it is easier to make a safe job on a single than on a multi-conductor cable.

Various materials were used for conduit several years ago. Vitrified clay is apparently the best material now in the market. For electric light and power purposes, a single duct tile is better than multi-duct, since it allows the breaking of joints, although it is more expensive to lay. Conduit is laid at various depths, but never closer than 30 inches to the surface. It is laid on cement mortar and surrounded on all sides by a three-inch layer of concrete. It is not a good plan to concentrate too much power in one line and for this reason more than 30 ducts are seldom laid in one line. Manholes vary in size, but will average 6 x 6 feet. If the conduit line is intended for carrying a number of through cables, the corners of the manholes are cut on a diagonal. This is a safer construction than with square corners. In hanging cables in a hole with square corners, they are apt to be bent too short in order to make a good looking job and later trouble will develop at the short bends. The organization of underground systems is in three divisions, the high-tension, low-tension and conduit systems. A large part of the work is done by contract under the supervision of the company's engineer. The company has had but little trouble with electrolysis except occasionally, where an Edison tube has been laid near the rails of the trolley line. We expect to break the lead sheaths on our 9,000-volt lines and insert insulating joints at intervals of possibly 3,000 feet and will also ground the lead sheath on each section in two or three places to guard against electrolysis.

DISCUSSION.

Following the paper, many questions were asked Mr. Carlton regarding matters taken up, in the paper. Mr. Carlton explained that a large number of ducts in a conduit line are not desirable, not only because of danger from interference with service, but because of the amount of heat given off where many cables are bunched in one line. The insulating compound, "minerallac," was devised by one of the company's engineers, and was considered better than paraffin, because of its greater dielectric strength.

Prof. Woodworth, in referring to the small amount of moisture that will break down the joint insulation cited some tests which he had carried on upon the influence of moisture on the dielectric strength of oil used for transformer insulation. Some oil submitted to him for test had shown itself to be sixteen times better than air as an insulator. Later when this oil was put into practical use, some of the results seemed to show that it was not as good as air. Some of the oil was brought back for a test and found to average only twice the strength of air as an insulator, some of it being less than this. Although water in the oil could not be detected by the sodium test, it was nevertheless suspected that the trouble was due to the moisture in the oil from condensation, inside the transformer case before the oil was poured in. It was found that the addition of a few hundredths of 1 per cent. of moisture to insulating oil would produce the same results in lowering its insulating qualities that had been observed on the oil under test.

Electric and Steam Traction in New York State.

The New York State Board of Railroad Commissioners, in their annual report remark: "At the time of writing this report the board is just in receipt of a complaint as to scarcity of cars for shipment of freight on steam railroads, which complaint it is to investigate. In its hearings on applications as to the building of new electric railroads witnesses have often repeated that they had been delayed and annoyed and out of pocket in their business through failure to get freight cars as needed from steam railroads. The steam railroad companies always answered that these happenings (if they occurred) were at times of unusual demand for cars. Admitting this, it would seem that there has been experience enough gained in late years by the companies to lead them to have heretofore provided what informed and intelligent judgment would consider sufficient freight carrying capacity, both in cars and engines, even though the cost for rolling stock which might be idle for part of the year would seem to some to be more than prudence would allow. That they are to some extent doing this is shown by increased expenditures for equipment. This general comment is to be in no manner considered a prejudging of the complaint on this subject just referred to.

"The proposal of the Pennsylvania Railroad to enter New York City by tunnel is a matter which should be noted here. It is not necessary to comment thereon as the result in benefit to the city of New York is patent. So, too, should be noted the great improvements to be made at the New York Central & Hudson River Railroad Company's Grand Central terminal in New York City, and the substitution of electricity for steam in its Fourth Avenue tunnel and further north with resulting benefit to the public. But little new steam railroad building has been done in the State during the year—only 62 miles.

"Passengers carried by steam surface roads numbered 87,388,825; grade crossings abolished were 105; total State's appropriation to date for separation of grades, $405,000. Not as much progress as should be, says the report, has been made in lighting cars.

"June 30, 1892, the length of street surface railroads in this State was 739.291 miles; June 30, 1902, it was 1,746.015 miles. Capital stock in 1892 was $71,634,449.32, and bonded debt, $65,822,452.88; in 1902 the capital stock was $204,591,357.50, and bonded debt, $218,508,474.10. The cost of road and equipment in 1892 was $135,506,415.74; in 1902 it was $420,888,704.51. Gross earnings in 1892 were $24,238,172.94; in 1902 they were $46,905,187.87. In 1892, 487,611,009 passengers were carried; in 1902 1,209,510,539 were carried, an increase of 721,899,530. These figures include the elevated railroads in Brooklyn and also include 'transfers.'"

Automobile for Wireless Telegraphy.

An interesting exhibit at the recent automobile show in Paris was a wagon for the wireless telegraph. In form it resembles a small omnibus; there is room inside for two operators and the receiving and sending machines. Fixed in a socket by the side of the wagon is a tall, jointed bamboo pole, nearly 60 feet high, which is supported by wire stays fastened to the roof of the wagon.

Berliner Decision.

The United States Circuit Court of Appeals for the First District, sitting at Boston, on January 16, handed down an opinion in the case on appeal of the American Bell Telephone Company *vs.* the National Telephone Manufacturing Company, in which priority of discovery of microphonic action is assigned to Hughes, and the claims in suit of the Berliner patent are limited to metallic electrodes. The opinion was written by Judge Colt, Judges Putman and Aldrich concurring.

It will be recalled that a decision by Judge Brown, of the United States Circuit Court, in the same case, was handed down February 27, 1901, which was adverse to the Berliner patent, and the recent decision appears to finally dispose of the microphonic issue. In Judge Brown's decision it was held: First, that Berliner's caveat of April 4, 1877, did not establish invention, and does not count as reduction to practice; that it was a project and that later caveats, the application and the record in the Patent Office show the failure and abandonment of this project. Second, that the invention described in the patent is radically different from the invention described in the application. Third, that the invention of the patent in suit was previously patented by Berliner in 1880. Fourth, that Edison was the prior inventor. In conclusion, the court said that the defendant's transmitters are inventions substantially distinct from that disclosed by the Berliner patent; that the conception by Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid metallic electrodes; that from his first conception Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent, and cannot be identified with it by any ingenious use of language.

The recent decision is along quite different lines, and is based almost entirely on the work of Professor Hughes, who is declared to be the prior discoverer of microphonic action, and that he embodied his discovery in the instrument which he was the first to term a microphone.

The opinion discusses the art of telephony from the time of Reis and give descriptions of all the types of transmitters revised down to the time of Hughes' discovery. It is stated that Reis failed because he had not discovered that a continuous current, which requires a constant contact between electrodes, was essential to transmit speech. Bell's discovery was that of the undulatory current, the only known current which will transmit speech. Bell thus supplied the current and what remained was to devise a better way of varying the resistance than was pointed out by Bell. This problem was solved by two discoveries which are now embodied in every commercial transmitter. The first was the discovery of the peculiar properties of carbon in varying the electrical resistance; and the second was the discovery of the remarkable effect of sound waves in varying resistance at a loose contact between solid electrodes. Edison made the first discovery and the fundamental question before the court is whether Berliner or Hughes first made the second discovery.

The opinion then proceeds to describe in detail the Reis transmitter, the Bell mercury transmitter, the Edison plumbago film and plumbago cylinder transmitter, the Berliner transmitter in suit, the Edison carbon transmitter, and finally the Hughes instrument, the consideration of which latter occupies the greater part of the opinion.

Contrasting the inventions of Berliner and Hughes, it is stated that the Berliner invention consists in a method of varying the resistance by variation of pressure at the point or points of contact between solid electrodes in constant contact. Professor Hughes's discovered the sensitiveness, the adaptability of the current at a loose or light contact to vary its resistance in conformity with the vibrations of the air produced by sound waves. His discovery lay in loose initial contact between the electrodes, and this is the essence of the microphone. With loose initial contact there is microphonic action; without loose initial contact there is no efficient microphonic contact. The discovery of Professor Hughes relates to the direct effect of the sonorous vibrations upon a loose contact, and a diaphragm is not essential. It will be impossible to find in the Berliner caveat or patent any conception of Hughes's discovery. Berliner's conception extended no further than the stage of Hughes's experiments in which the latter placed the broken ends of a wire in contact, and began his experiments on the effect of sonorous vibrations at different degrees of constant pressure, which finally led to his discovery of microphonic action.

Referring to Berliner's account of his conception of his invention, the opinion says that this conception is not that of Hughes, because the essence of microphonic action which resides in loose contact is entirely wanting. Berliner's conception does not reach to the character of the initial contact, and therefore does not even approach microphonic action. If Professor Hughes had stopped his experiments when he placed the ends of his severed wire in contact, he would not have discovered microphonic action. The conception of Berliner, by reason of the absence of any comprehension of microphonic action, when embodied in a transmitter produces an instrument which is sometimes operative and sometimes not. Berliner's conception of varying pressure at the contact point or points of contact is meaningless as a conception of microphonic action. A conception of microphonic action which omits loose contact leaves out the very essence of the thing to be conceived. Berliner started with a firm initial contact between electrodes, and his theory was that the vibrations of the diaphragm would lessen the contact. This, however, is the reverse of microphonic action, which starts with a loose initial contact, and, consequently, a greatly diminished flow of current.

In referring to the Berliner application of June 4, 1887, the court states that an intelligent and satisfactory interpretation of this document bids defiance to the human understanding; and assuming that Berliner when he filed his caveat on April 14, 1877, had already made Hughes's discovery of microphonic action, his caveat of May 9, and his application of June 4, become incomprehensible. It was not until more than a year after the publication of Hughes's article of May 9, 1878, that Berliner described the necessity of loose initial contact between electrodes.

The court controverts the claimant's contention that Hughes's discovery of microphonic action is disclosed in the Berliner caveat. What Hughes disclosed to the world, as stated above, was not varying the pressure at the point of contact; nor did the essential thing which he discovered lie in the difference of pressure at different points of contact. His discovery resided in loose contact; or rather, in the remarkable effects of sonorous vibrations in varying the resistance at the loose contact. "Variation of pressure at a point of contact" may be descriptive of Berliner's invention, but, to say the least, it is a mistaken and misleading description of microphonic action and of Professor Hughes's discovery.

The opinion reiterates that Berliner had no conception of Hughes's discovery of microphonic action; that he does not disclose such a discovery in his caveat or patent, and that if his transmitter operated as a microphone, it was without any knowledge on his part of the microphonic principle. Professor Hughes's discovery cannot be read into the Berliner caveat or the claims of the Berliner patent. It was Hughes and not Berliner who discovered the "transition resistance" upon which the complainants dwell, and it was the former who introduced it in the microphonic art, and the effects of sound waves in varying such resistance. It cannot be said that Berliner made any discovery of pressure or variation of pressure, which has proved of any utility in the art. His discovery of the variation of pressure at a point of contact between metallic electrodes in the telephone transmitter possesses little utility and was practically worthless.

The opinion closes with the following summary of the conclusions of the Court respecting the variable-resistance transmitter:

We find that Bell, in March, 1876, discovered that the minute atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between a solid electrode and a liquid electrode in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, in February, 1877, discovered that the minute atmospheric vibrations due to sound waves, would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes of different conductivity in constant contact, one metallic and the other hard rubber-covered with a plumbago film, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Edison, on April 1, 1877, discovered that the minute atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure between two solid electrodes in constant contact, one metallic and the other compressible plumbago, produced variations of electrical resistance, whereby speech may be transmitted.

We find that Berliner, on April 14, 1877, discovered that the minute

atmospheric vibrations due to sound waves would cause the diaphragm to vibrate, which vibrations, by varying the pressure at the point of contact between metallic electrodes in constant contact, produced variations of electrical resistance, whereby speech may be transmitted.

All of these discoveries, when embodied in transmitters, were inventions, but none of them was a commercial instrument, or solved the problem of a practical long-distance speech transmitter.

We find that, in the fall of 1877, Edison discovered the carbon electrode; that this discovery represents the first marked advance in the transmitter art since the 1876 Bell patent; and that the carbon electrode is found in every commercial battery transmitter.

We find that in May, 1878, Professor Hughes discovered microphonic action, or the fact that sound waves produce remarkable variations of resistance at a loose or feeble contact between solid electrodes in constant contact, whereby speech may be transmitted; that the principle he then made known is utilized in every practical battery transmitter; and that he embodied his discovery in an instrument, which he was the first to term a microphone.

We also find that Edison's discovery of the carbon electrode and Hughes's discovery of microphonic action solved the problem of a variable-resistance transmitter, whereby speech may be transmitted long distances; and that both these discoveries are embodied in the defendants' transmitters.

We also find that the two claims of the Berliner patent in suit, although upon their face open to the objection of excessive breadth, may be sustained when read in connection with the specification, provided they are limited to metallic electrodes; and that, when so limited, the defendants' transmitters do not infringe.

The final conclusion is that the decree of the Circuit Court must be affirmed on the ground of non-infringement, and costs were awarded to the appellees.

The Street Railways of Massachusetts.

From the advance sheets of the Massachusetts Railroad Commissioners' report, covering operations of Massachusetts steam railroads for year ended June 30, 1902, and street railways for year September 30, 1902, it would appear that the trolleys are gaining over the steam roads in mileage, earnings and net earnings. The trolleys have gained 11 per cent. in the year in mileage; the steam roads declined 1 mile. The gross trolley earnings increased 7.5 per cent.; the steam, 5.5. The net trolley earnings increased 4.5 per cent.; the steam, 1.8. Below follow the street railway statistics for four years past:

	1902.	1901.	1900.	1899.
Gross	$24,918,684	$23,179,304	$21,387,641	$19,519,338
Op. ex.	15,912,852	14,565,141	13,159,947	12,378,487
Net	$9,005,309	$8,614,163	$8,227,694	$7,146,851
Charges	5,616,458	5,215,980	5,190,192	4,637,909
Balance	$3,388,851	$3,398,183	$3,037,502	$2,502,942
Dividends	3,138,711	3,417,117	2,409,874	2,318,398
Surplus	$250,140	Def. $18,934	$627,628	$184,544

Gross assets of Massachusetts street railways, gross liabilities including capital stock and surplus, with percentage outstanding capital, compare as follows:

	Assets.	Liabilities.	Surplus.	% sur.
1902	$123,200,558	$119,441,792	$3,758,766	6.26
1901	107,250,656	103,598,042	3,652,614	6.76
1900	98,700,075	95,062,946	3,637,129	7.43
1899	85,764,845	83,279,891	2,484,954	6.01
1898	77,607,325	75,889,625	1,717,701	4.41
1897	67,509,976	66,483,414	1,026,502	3.14
1896	62,187,775	61,198,746	889,028	3.48
1895	56,641,581	55,357,081	855,590	3.06
1894	53,641,581	53,020,295	621,286	2.30
1893	50,120,273	49,589,688	540,585	2.09

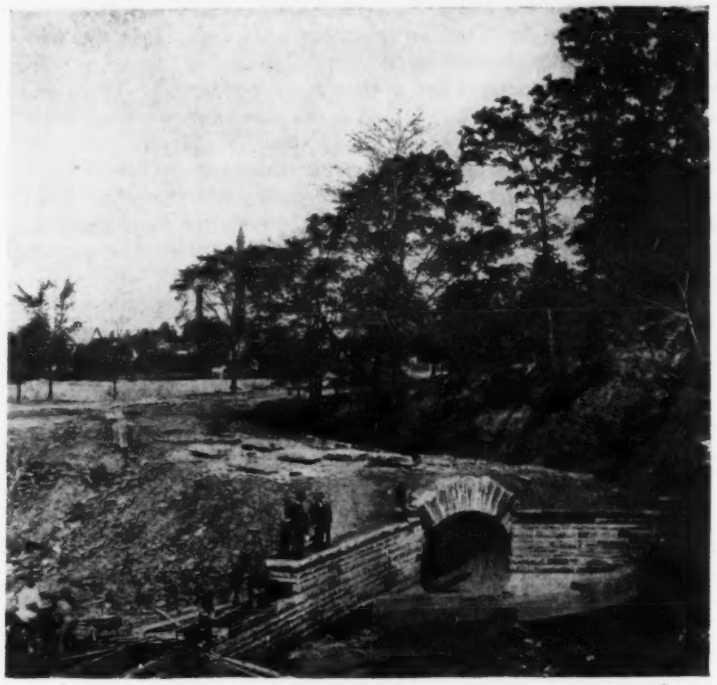
The board makes no important recommendations. It says: "The question of cheap morning and evening trains in this commonwealth is a business problem, to be solved upon business principles, and not one of enforced contribution to a public charity, either from the railroads or from the most prosperous part of the community to the less prosperous. An extended inquiry into fares upon railroads outside of this State seems to show that, however unequal and unscientific the present arrangement of fares upon the railroads having terminal in Boston may be, as a whole, our suburban fares are among the lowest of such rates to be found anywhere."

Solution of a Vexatious Problem in Street Railway Work.

By W. B. Arthur.

There are standing problems confronting some street railways which year by year bring about more intolerable conditions, and seem more difficult of solution. In many localities, street railways are annually inundated by spring freshets, and car barns and power houses are damaged, tracks undermined, bridges weakened or swept away, and general havoc wrought by what is at most seasons of the year but an insignificant brook. Such a condition of things has existed for many years in the city of Cleveland, Ohio, where damage to property has resulted annually from the overflow of Giddings Brook, on the east side of the city, until Mayor Tom L. Johnson, who is, as everybody knows, an experienced street railway man, set about procuring needed practical relief, which had been ineffectually talked of in various ways for more than fourteen years.

The first step was to lift an injunction which had for years discouraged all endeavor. This done, steps were at once taken to turn the waters of the brook from its accustomed course into the waters of Doan Brook, some half mile or more northward. At a point where



PROTECTING ELECTRIC RAILWAY PROPERTY AGAINST FRESHETS.

high hills on either side afford natural retaining walls, and at an angle in the channel, a dam was constructed, consisting of a rock-faced wall of Amherst stone, filled in with concrete, 120 feet long. The wall is built with an angle in the center, as shown in the accompanying illustration, the two wings converging to the mouth of a tunnel in the angle. This brick-lined tunnel is 9 x 11 feet in its interior measurements throughout its entire length, which is 3,000 feet. The mouth at the exit flares to 9 x 14 feet, and is protected by a weir wall from rocks and debris brought down the ravine. The tunnel excavation has been made through shale rock throughout its entire length, and the work, which is now practically completed, has been for a year under construction.

The illustration herewith given may prove suggestive to railway companies in other localities where need exists for the curbing of brooks and the lessening of their destructive force, and may lead to the solution of a problem which has been puzzling some other street railway managers as the Giddings Brook question had done those of Cleveland.

Wireless Telegraphy at Key West.

The government, we are informed, is preparing to establish a wireless telegraph station at Key West for the purpose of maintaining communication with Havana.

The Construction of Aerial Telephone Lines—II.

By Arthur V. Abbott, C. E.

THE POLE AS A COLUMN.

THE vertical stress to which poles are subjected due to the weight of the line and snow is the least important of all they are called on to resist, and while lines have been known to fail by the simple crushing of the poles such cases are rare. Each pole must carry its own weight plus that of its cross arms, half the weight of each span of wire and cables on either side of it, plus any burden of snow and sleet. The weight of various sizes of poles will average about as in Table I.

TABLE 1.

WEIGHT OF POLES.

Height in feet.	Weight lbs.	Height in feet.	Weight lbs.	Height in feet.	Weight lbs.
25	400	40	650	55	1500
30	450	45	1000	60	2000
35	550	50	1250	65	2700

A ten-pin cross arm in place with half the weight of the wire in either adjacent span (allowing 42 poles per mile) will be from 80 to 100 pounds for .080 or .104 copper wire. Iron wire lines are from 10 per cent. to 15 per cent. heavier as larger gauges are common. The weight of aerial cable per pole, including messenger wire will be about 650 pounds for 25-pair cable, 800 pounds for 50-pair and 1,000 per 100-pair. Snow load is the most difficult to estimate. Ice coatings on a No. 10 wire 6 in. in diameter are veraciously reported, but are fortunately of the rarest occurrence. One and two inches of sleet are by no means uncommon, and there are many instances annually when the sleet load is sufficient to rupture the wire itself. So 150 to 200 pounds per wire and 700 to 2,000 pounds per cable are well within the range of each winter's possibilities. Thus each pole of 25-ft. line with two ten-pin arms is burdened as follows:

Pole	400 lbs.
Arms	200 "
Snow	3,000 "
Total	3,600 "

A 65-ft line with 12 ten-pin arms and four cables would impress on each pole base the following load:

Pole	2,700 lbs.
Arms	1,200 "
4 Cables	3,450 "
Snow	20,800 "
Total	28,150 "

The pole is column fixed at one end (the base) and unsupported at the other (the top). Hodgkinson shows that the strength of such a column made of white pine is given by the formula:

$$W = 4\frac{d^4}{l^2}$$

in which W equals the supporting power of the pole in tons of 2,000 pounds, d the diameter of the pole in inches at the base, and l the length between the ground and the lowest arm in feet. For a 25-ft. line, $W = \frac{4 \times 8^4}{20^2}$ (approximately) 40 tons. This is the ultimate strength; and a factor of safety of at least 10 should be allowed, so the working crushing strength is 4 tons or 8,000 pounds, a little over double the load imposed as shown above. Similarly for a 65-ft. line.

$W = \frac{4 \times 12^4}{30^2}$ = (approximately) 92 tons, or say ten tons for working load, which is a little less than the actual line load. Tall, heavy lines, therefore, have much less safety factor than low, light ones. This deduction corresponds with experience, for the large lines are usually the sufferers. If any other wood be used the formula may be corrected by the data of Table II.

Thus white pine is allowed a crushing strength of 5,000 pounds per square inch and yellow pine 5,300 pounds; hence a yellow pine pole will be $\frac{53}{50}$ as strong as a white pine one.

2nd. *Longitudinal Tension.*—It is common practice in building pole lines to pull each wire up to a tension of 150 pounds at aver-

TABLE 2.

CRUSHING STRENGTH OF TIMBER.

Variety.	Crushing Weight in lbs. Per Square Inch.
Ash	5,000 to 8,000
Cedar, red	4,500 to 5,900
Chestnut	5,350
Elm	6,000 to 10,000
Oak	4,000 to 9,000
Pine, yellow	5,300 to 6,500
Pine, red	6,000 to 7,500
Pine, white	5,000 to 6,000
Spruce, white	4,500 to 6,000

age temperature of say 60° F. The messenger strands of aerial cable carry a tension of from 3,000 to 4,500 pounds. If, therefore, a wire or cable is dead-ended, or so secured by the tie or other fastening that it cannot slip, the cross arm and pole may be subjected to this stress. So a ten-pin arm on which all wires are dead-ended carries a stress of 1,500 pounds. In straightaway work even when lines are dead-ended for transposition the tension of one span practicaly balances that of the succeeding one, and the arm and pole is released, but where a wire or messenger actually stops the entire tension must in some way be taken up, as will presently be shown.

3rd. *Tension Due to Curves or Corners.*—When a pole line changes its direction as at curves or corners the longitudinal tension of the circuits manifest themselves in a most striking manner. Problems in pole line stress are most conveniently solved by graphical method. Fig. 4 is a plan of a line with one ten-pin arm $B\ C$ attached to the

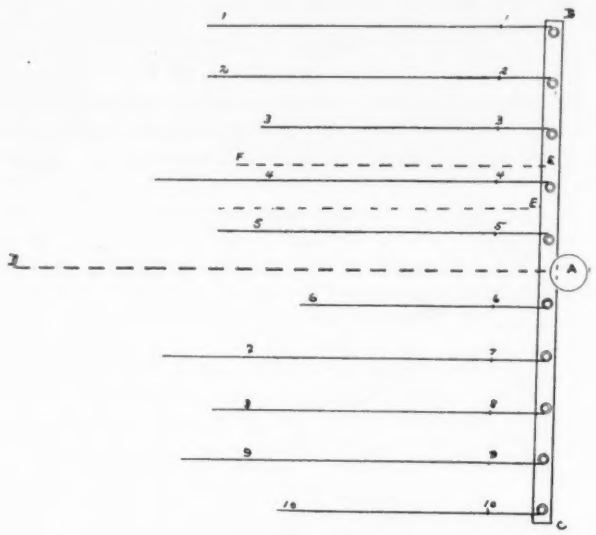


FIG. 4.—PLAN OF POLE LINE.

pole, A. Suppose the various wires represented by 1, 1, 2, 2, etc., to be dead-ended on the pins and to be drawn up to a tension of 150 pounds each, what is the force exerted on the pole and which way does it pull? Evidently each wire pulls 150 pounds in the direction it runs. If, therefore, a scale of pounds be assumed (in this example 350 pounds to the inch) and such a distance be laid off along each wire as represents the pull of the wire according to this scale, a series of lines are obtained which represent in magnitude and direction the tension of each wire on its pin. These lines are represented at 1, 2, 3, 4, etc. As the wires are parallel all the tensions are parallel, and a line, $A\ D$, parallel to the wires, whose length is the sum of all the separate tensions, represents the total tension, and further as all the separate tensions are equal the resultant is applied at the middle of a line drawn through all the pins, or at the point A, where the arm is bolted to the pole, and the pole is pulled in the direction $A\ D$ with a force of 1,500 pounds. Suppose that only eight wires had been placed on the cross arms of Fig. 4, wires 9 and 10 being omitted. The point of application of the resultant will be midway between wires 4 and 5, at E; that is, at the middle point of the line drawn through the center of the pins to which the wires are attached. The magnitude of this resultant

evidently will be the sum of 1, 2, 3, etc., up to and including 8, or 1,200 pounds. As all the wires are parallel to each other the direction of the resultant will be parallel to the direction of the wires. But now the resultant does not pass through the center of the pole but is 16 inches away from it, and hence tends to twist the pole in its hole. As the resultant is 16 inches away from the center of the pole; this twisting effect is found by multiplying the intensity of the resultant, 1,200 pounds, by 16, the distance that it is away from the center, giving a force of 1,500 foot-pounds as the tendency to turn the pole around in its socket. A sheet of cross section paper is most convenient for plotting stress diagrams, for the lines of the paper enable one to draw and read results directly. Fig. 5 is

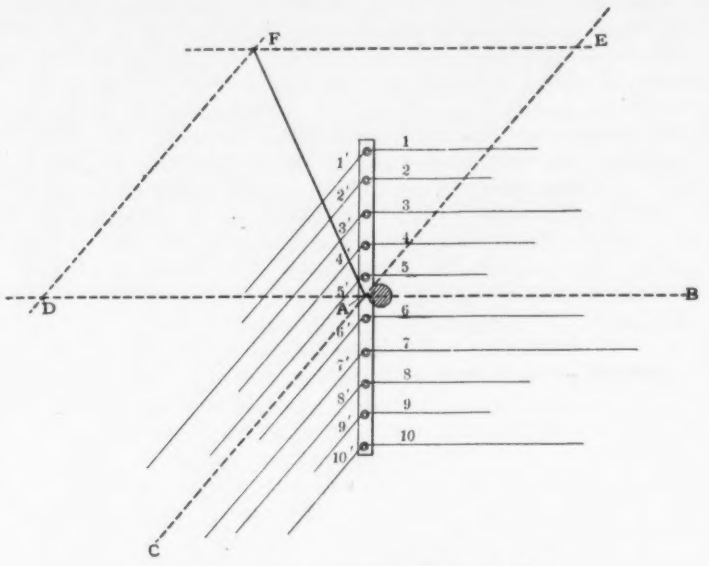


FIG. 5.—PLAN OF CORNER IN POLE LINE.

an example of a corner in a pole line. The various wires, 1, 2, 3, etc., to 10, are assumed to reach the pole, *A*, in direction parallel to the lines in the paper and to turn on the pole and depart in the direction 1′, 2′, 3′, 4′, etc. The tension on each wire is assumed at 150 pounds and is represented by one of the large squares of the paper. As already described, the resultant of the tension in all the circuits leading *to* the pole is represented by the line *A B*. Similarly the resultant of the tension of the lines leading away from the pole is represented in magnitude and direction by the line *A C*. Draw the line *A D* a continuation of, and equal to, *A B*, and draw *A E* a continuation of, and equal to, *A C*. Complete the parallogram, *A E F D*, by drawing the line *E F* equal and parallel to *A D*, and the line *D F* equal and parallel to *A E*, draw the line *F A*, then *F A* represents in magnitude the resultant of all the tension in such a corner pole. This stress the pole must resist either by its own intrinsic stiffness or by the aid of a guy. The tension of the circuits tends to pull the pole toward the inside of the curve or corner, hence to resist this the guy must be set away from the corner in the line *A F*. Such a diagram then shows both the tension on the guy and the direction in which it must be placed. It is easy to see that by making an elevation drawing of a pole line the same method may be used to determine the magnitude, direction and point of application of the resultant of the forces that act on the line in a vertical plane. In a line carrying open wire only, the resultant in a vertical plane will, if the arms are all filled, lie on the center of the arms and be equal to the sum of all the tensions of the individual wires. If there are aerial cables the point of application of the resultant will move toward the cable arm just in proportion as the stress on the messengers exceeds the stress of the open wire.

Resistance to Bending.—When a pole is subjected to a horizontal force, in any direction, it tends to bend in the direction toward which the force is directed, the fibres of the wood lying on the side of the pole toward the direction of the force are compressed, while those on the opposite side are stretched. If the pole be cylindrical it can be shown that the section along which rupture will take place will be at the surface of the ground, when the diameter of the pole, at the point at which the force is applied, is equal to, or greater than two-thirds of the diameter at the ground surface. When the diameter of the section at the point of application of the force is *less*, rupture takes place above the surface of the ground at that point where the diameter of the pole *is* two-thirds of the diameter at the point of application of the force. The horizontal stress, which will cause rupture, when the section of rupture coincides with the ground level, is given by the formula, $F = \frac{\pi R^3 T}{4 L}$, where R is the radius of the section at the surface of the ground, L is the height above the soil to the point of application of the force, T the resistance to rupture per unit of section of the material composing the pole, and F the force causing rupture. To find the diameter of a pole to resist any given tension, with say a factor of safety of 10 this formulæ may be transformed and will appear as follows:

$$R = \sqrt[3]{\frac{40\,F\,L}{\pi \times T}}$$

In case the diameter of the section of the pole at which the resultant of all the forces acting upon it is applied is less than two-thirds of the diameter at the level of the ground, the section at which rupture will take place will be above the ground, and the force, F, necessary to break the pole, can be found, but the formula is much more complicated and is given below:

$$F = 27\,\frac{\pi\,R_1^2\,(R - R_1)\,T}{16\,L}$$

in which R_1 is radius of the section at which the force is applied, while the other symbols have the same meaning as before. The values of T in the preceding formulæ are the tensile strengths of the various kind of wood used for poles. For the purpose of calculation the values shown in Table 3 are fair to assume.

TABLE 3.

TENSILE STRENGTH OF TIMBER.

Variety.	Breaking Weight per Square Inch in lbs.
Ash, American	5,500 to 17,000
Cedar, American	11,400
Chestnut	7,000 to 13,000
Cypress	6,000
Elm	6,000 to 10,000
Oak	10,000
Pine, yellow	5,000 to 12,000
Redwood, California	10,800
Spruce	5,000 to 10,000

As a practical illustration assume a 30-foot line with two ten-pin arms all full.

Case First.—Suppose all wires to be dead-ended, the tension of the line will be 3,000 pounds; the point of application of the resultant is in the center of the pole midway between the two arms, or say 28 ft. from the ground. The radius of the point of application of the resultant is about 3¾ in. (7-in. top pole), the radius at the ground (standard pole) about 4 in., hence the upper diameter is more than three-fourths of the ground diameter and the pole will break at the ground and

$$F = \frac{3.14 \times 3.75^3 \times 11{,}400}{4 \times 28} = 16{,}800 \text{ lbs.}$$

as the stress applied is 3,000 pounds the pole would hold, but would have so little margin as to probably fail with the first sleet storm.

Case Second.—Assume a similar line, but with only one cross arm to turn a corner, as shown in Fig. 5. For one cross arm the resultant stress tending to bend the pole is shown by Fig. 5 to be 1,275 pounds. The strength of the pole is the same as previously found, thus showing a factor of safety of thirteen. Such a pole in a sheltered location would be sufficient, but would be better if reinforced with a guy. From these examples it is easy to see that when a number of wires are dead-ended, or when there is an angle or curve of any magnitude, the horizontal stress soon rises to such proportion as to be far beyond the resistance to flexure presented by any ordinary pole.

Wind Stress.—Of all the forces operating against a pole line wind is far the most difficult to evaluate, and the very best estimates frequently go astray. Some lines which have withstood the attacks of the elements for years will suddenly, and under seemingly slight provocation fail. Recorded tests on wind pressure are fragmentary and misleading. Some well-received data show that a gale blowing 70 miles per hour exerts about 25 pounds per square foot of area normal to the wind. On a sleet-covered line of 50 wires this would amount to about 4,500 pounds. But it is common experience for lines that should successfully withstand a greater stress to fail at presumably less wind velocity. Two explanations have been advanced, one that occasional gusts cause far greater instantaneous

pressures, the other that such gusts set the line swinging and vibrating in a manner to hasten its destruction. Probably both of these causes operate, and very possibly to a far greater extent than is usually imagined. Wind pressures attack the line from every conceivable direction, but in a general way they may be relegated to the category of the horizontal forces that act transversely to the line. Thus intensity is so difficult to estimate that in exposed locations about the only method is to build as strongly as possible, and then rebuild when the line goes down. Thus it is shown that all the forces acting on a pole line may be either resolved into vertical or horizontal ones. For the vertical ones strong straight poles form the only resource; but the horizontal stresses, particularly those which are developed at curves, angles and terminal poles, may be resisted by guying.

Opinions on the Berliner Decision.

President F. P. Fish, of the American Telephone & Telegraph Company, is quoted as follows by the Boston News Bureau:

"President Fish, of the American Telephone & Telegraph Company, says the decision of the United States Court of Appeals in the Berliner patent case leaves the situation in relation to this patent just where it has been. The court holds that the instruments manufactured by the National and Century Telephone Companies do not infringe upon the Berliner patent. Mr. Fish says, however, that the Berliner patent has been of no practical validity for a great many years, hence the decision is of no great importance. He is not prepared to say whether or not the case will be carried to the Supreme Court."

Judge James M. Thomas, president of the Independent Telephone Association of the United States of America, said that the Court of Appeals sustains the court below on the ground of non-infringement, holding that Berliner is entitled to his patent so far as the use of metal electrodes is concerned. All the commercial telephones, however, employ carbon electrodes, which do not infringe the Berliner patent, so that the decree is a complete victory for defendant and is of great interest all over the United States, as it involves the investment on the part of anti-Bell companies of two hundred millions of dollars, which has been invested in the opposition to the American Bell Telephone Company. He considers that in the successful termination of this great case, due recognition should be given to the parties who have been bearing the burden of the fight. After the decision in the government case in which the Supreme Court sustained the decision of the Court of Appeals, refusing to cancel the Berliner patent on the grounds of fraud and other claims contained in the bill of the government, nothing remained to be done but for those interested outside of the American Bell Telephone Company who had invested in telephony, to bend their efforts towards the defeat of the Berliner patent, so far as it related to what is known as the carbon microphone. Immediately after the organization of the Independent Telephone Association of the United States of America at Detroit, in 1897, a committee was appointed consisting of Hon. H. D. Critchfield, of Chicago, formerly of Ohio; Judge Savage, of Pennsylvania, and himself, who undertook to assist the defence in the three cases brought against manufacturers by the American Bell Telephone Company in the city of Boston. The National Telephone Manufacturing Company, which has been the prominent party in all this litigation, had previously retained Mr. Edward P. Payson, of Boston, as its counsel; and arrangements were effected whereby the three cases (on account of involving the same issues) were to be considered as one, and that Judge R. S. Taylor, of Fort Wayne, Ind., should be accepted as a representative of an outside interest to assist in trying this case.

"Only those who have been through similar experiences can appreciate the amount of work that was expended in the preparation of the defence and in financing a plan whereby this great victory has been brought to the independent telephone interests. Mr. Edward P. Payson has devoted years of study to the troublesome legal and technical questions involved in this case. He has worked faithfully and deserves the everlasting esteem of all the investors of the $200,000,000 which were jeopardized by this suit. Judge R. S. Taylor, having been on the government case, and being more or less familiar with the questions involved, immediately took up the work, and has proven a master in the handling of the legal and technical questions involved therein. No case ever had more devoted lawyers, and the courts have had no case involving greater and more universal interests than this famous Berliner case. The Litigation Committee of the association, consisting of Hon. Hugh Dougherty, Bluffton, Ind.; Hon. S. P. Sheerin, of Indianapolis, Ind.; Hon. H. D. Critchfield, of Chicago; E. B. Fisher, of Grand Rapids, Mich., and myself, have worked and contributed in every way possible to the support of those who had undertaken the defeat of this patent."

Mr. E. P. Payson, of Boston, chief counsel of the National Telephone Manufacturing Company, et al., gives the following information as to the bearing of the decision:

The second defence, namely, the insufficiency of the Berliner application, is not specifically passed upon. The fifth defence, double patenting, is not alluded to. The Bell mercury transmitter operated by variations of pressure is affirmed, but the apparatus is not held to have been sufficiently practical to be an anticipation. The third (Edison) defence is affirmed as to the Edison (1877) discovery and his April 1st apparatus, and his carbon electrode, which, in the fall of 1877, "represents the first marked advance in the transmitter art since the 1876 Bell patent; and the carbon electrode is found in every commercial battery transmitter"; and the value of the work of Prof. Hughes with reference to "variations of resistance at a loose or feeble contact between solid electrodes in constant contact," is considered at length. The defence upon which the opinion mainly rests is the fourth defence, namely, that Berliner really contributed nothing to the art of telephony; that his rights are purely technical; and that the defendant's transmitters contain nothing derived from Berliner and are not within or an infringement of his patent, even if the patent be valid; as to which defence at page 238 of the brief we said that even if Berliner tried his metal electrodes before Mr. Edison invented carbon, considering that carbon was not implicit in Mr. Berliner's work, but was produced by Edison, "the Berliner patent in suit must be given a narrow scope so limited as to not include either form of the defendant's transmitters. It is submitted that this view presented under the fourth defence is in every respect a conservative view of the premises; that it leaves to Mr. Berliner the very utmost that can be reasonably claimed by him; that it concedes to Mr. Edison only that of which he was evidently the discoverer and the inventor." We have thus gained in this court all that was hoped to be gained in having them affirm the decision of Judge Brown in this way, and it leaves nothing of the Berliner invention of any practical commercial value, as all the commercial telephones used throughout the world have carbon electrodes.

President Sheerin, of the New Long-Distance Telephone Company, of Indiana, said "that if the Berliner patents had been sustained 90 per cent. of the equipment used by telephone companies other than the American Bell and its tributaries would have been infringement of the Bell Company's patents. The independent companies of Indiana have 75,000 telephones and they would all have been sufferers by an adverse decision. The importance of the decision is great to them because their ability to continue in business was involved in their right to use the independent manufacturer's products."

Wireless Daily Papers.

With reference to recent reports, a cable dispatch from London of January 16: Daily papers will not be published for the present, at least, on Atlantic steamers. The Marconi Company will undertake only to send messages forty miles seaward, and news bulletins simply will be displayed in various parts of the incoming steamers. It is stated that Mr. Marconi is at work upon a new form of wireless instrument, the purpose and object of which is to definitely locate the whereabouts of ships at sea which may be drifting helpless by reason of some derangement of its machinery. The object of this instrument is for use in just such an emergency as that in which the St. Louis was involved. By means of this instrument the exact latitude and longtitude of the helpless ship may be determined and its course followed from day to day. With this information in hand, vessels may be dispatched to the aid of the helpless steamer, and by means of the usual form of wireless instrument the relief steamer may be kept posted as to the changes of position of the drifting vessel from day to day. It is understood that by means of the new instrument greater possibilities are open to shore stations in the matter of communication with vessels than by means of the ordinary form of wireless instrument now in use.

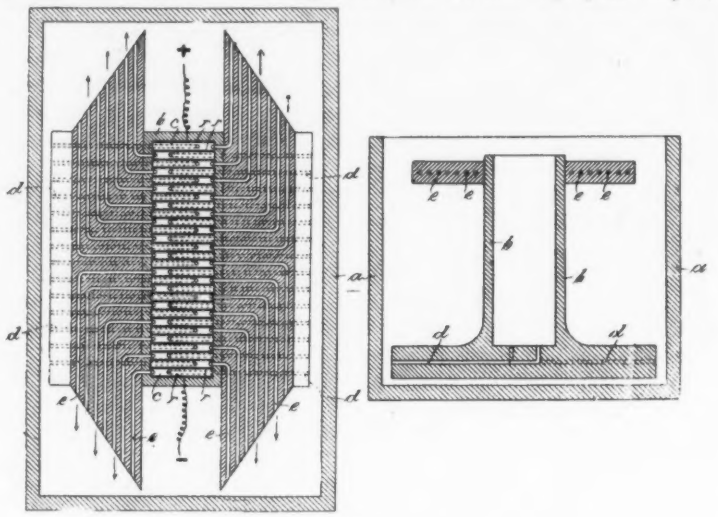
Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

PRODUCTION OF BLEACH LIQUORS.

The "series" arrangement of electrodes for electrolytic work has been applied chiefly to the refining of copper, and the production of hypochlorites and of chlorates by the electrolysis of chloride solutions. These are not the sole applications of the bipolar system of connections, for electric furnaces, both arc and incandescent, have been constructed according to this plan; but they are the branches of the art in which no disadvantage is to be apprehended from the mixture of the soluble anode and cathode products of the electrolysis, in which a close juxtaposition of the electrodes is both feasible and desirable, and in which, therefore, the arrangement affords substantial advantages.

In the series system the end electrodes only are connected to the source of current; the intermediate, unconnected or "bipolar" electrodes constitute partitions or partial partitions separating the electrolyte into successive bodies. If these several bodies of electrolyte are absolutely distinct, the current can only pass from one to the other through the separating plates, which accordingly assume an opposite polarity on opposite sides. If, however, as is always necessary for continuous work, these bodies of electrolyte communicate with one another, either directly or indirectly through a common supply or discharge main, the current will pass in part



HORIZONTAL AND VERTICAL SECTIONS OF ELECTROLYTIC VAT.

through the electrolyte around the intermediate plates, and the part of the current which so passes is largely wasted. Hitherto this fact has been generally disregarded, and numerous patented devices for the production of bleach liquors, etc., comprise so-called bipolar electrodes consisting of perforated plates, wire cloth, or even assembled plates lying loosely in a large tank. Such devices are, of course, almost inoperative.

Mr. Max Haas, of Aue, Germany, describes a series of constructions in which account is taken of this current loss. These devices are without doubt the most efficient vats for the electrolytic production of hypochlorites which have been offered. In all cases the principle is to afford communication between the several bodies of electrolyte contained between the plates, but by means of passages so narrow, long and tortuous that the current loss occasioned thereby is negligible for practical purposes.

One form of the apparatus is shown in the accompanying figure, which shows a horizontal and a vertical section. The electrolytic vat, *b*, is divided by the carbon plates, *r*, into a series of compartments, *c*, and the end plates are connected to the source of current. Each compartment, *c*, communicates at its bottom through narrow passages, *d*, with a containing vessel, *a*, which holds the main body of the electrolyte, in this case a sodium chloride solution. Each compartment, *c*, also communicates at its top with the same vessel, *a*, through long, narrow and curved conduits, *e*, as shown.

When the current is passed there is considerable evolution of gas at the electrodes, and the specific gravity of the electrolyte in the compartments, *c*, is thereby reduced; these portions of electrolyte are, therefore, displaced continuously by the heavier liquid entering through channels, *d*, and overflow through channels, *e*, descend through the external vat and return again to the compartments. A continuous circulation is thereby maintained, and the several channels are of such form and size as to prevent any substantial loss of current by short-circuiting between opposite sides of the intermediate electrodes. In the above construction the electrolyte passes through the compartments simultaneously; it is often desirable, however, that the electrolyte should pass in succession through the compartments, and several arrangements for accomplishing this without loss of current are suggested. In every case, however, the principle is as above stated, to afford communication between the compartments by long and narrow channels.

ANODES FOR ELECTROLYTIC WORK.

The basic principle of two methods recently patented to Herbert H. Dow, of Midland, Mich., for the manufacture of carbons suited particularly for electrolytic work, is to coat each particle of ground coke or other carbonaceous material with the minimum quantity of such binding agent as coal-tar, etc., which will serve the purpose of binding the particles into a coherent pencil or rod. This gives a carbon of the maximum density and electrical conductivity.

The inventor states that if carbon particles be mechanically mixed, however intimately, with pitch, the quantity of the binding agent which will adhere to the particles will vary, and especially that the smaller particles will receive more than their proportionate share. According to the present invention, the cold ground carbon is dropped through the heated vapor arising from the binding agent, and the latter condenses upon each individual particle, coating them intimately; and what is more essential, the amount of coating is proportionate to the size of the particle. This is because the action is one of condensation, and the larger particles are able to condense a quantity of the binder in proportion to their weight before they are themselves heated to the temperature at which no further condensation occurs.

An alternative method which gives intimate distribution of the binder over the coated particles depends upon the use of the binding agent, tar, pitch, etc., in the form of an emulsion with water. This method of course secures a uniform distribution of the binding agent, and therefore a uniform conductivity of the resulting electrode; it does not, however, limit the quantity of the binder to the practicable minimum, as is the case with the other method.

New Telephone Patents.

The present-day increase in what may be called "the telephone density" is gradually making itself felt at the Patent Office. With this increase of this density, i. e., increase in the number of telephones per unit of geographical area, in order that a prohibitive number of central offices may not be required, switchboards of larger and larger capacity must be constructed. Unfortunately, the size of oper-

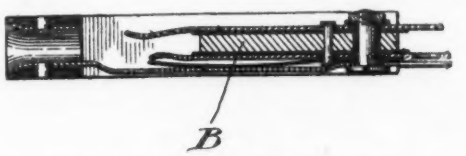


FIG. 1.—CLAUSEN TELEPHONE JACK.

ators does not keep pace with the increasing central office unit, and consequently to bring the entire multiple of large switchboards within reach of the operators, smaller and smaller apparatus must be used. To meet this requirement, the metal frame jack was devised, specimens of which have been appearing from time to time.

In the patent issue of January 13 a patent granted to H. P. Clausen describes another design for such a multiple jack. In Fig. 1 this jack strip is shown in section. As will be seen, the jack is of the type known as "three point"; that is, it is adapted to register with its plug to control three contacts. The body of the jack strip is entirely of metal. This is given a U-shape, so that it forms both the supporting and clamping lugs at the ends of the strip and the rear plate shown at *B*. Upon the front of the legs of the U the usual hard rubber face-strip, carrying the jack thimbles is mounted; while the jack springs are mounted upon the metal rear strip through the agency of a bolt and steady pin, the necessary insulation being maintained by the use of suitable sheets, strips and bushings of hard rubber. This is well shown in the figure. The excessive number of pieces of insulation to be provided and maintained in position appears to be objectionable, but the inventor must feel rather sure

of his position, for the chief claimed novelty is in this very design of metal strip with its allied insulating pieces.

Two new telephone transmitters appear in this patent issue of January 13. One of these is the invention of M. R. Hutchison, while the other was devised by C. C. Cadden. These two transmitters are very different, the first being based upon the same principle as Edison's inertia transmitters of some years ago; while Mr. Cadden's invention consists chiefly in a novel form of flexible joint between the movable electrode and the carbon chamber.

Fig. 2 shows views of both of these transmitters. To the left is a diagrammatic plan and a section of Mr. Hutchison's transmitter and to the right is a sectional view of that of Mr. Cadden.

Referring first to the inertia transmitter, it is seen that the diaphragm is placed horizontally and carries at the center of its upper surface a symmetrical group of electrodes of carbon cemented to

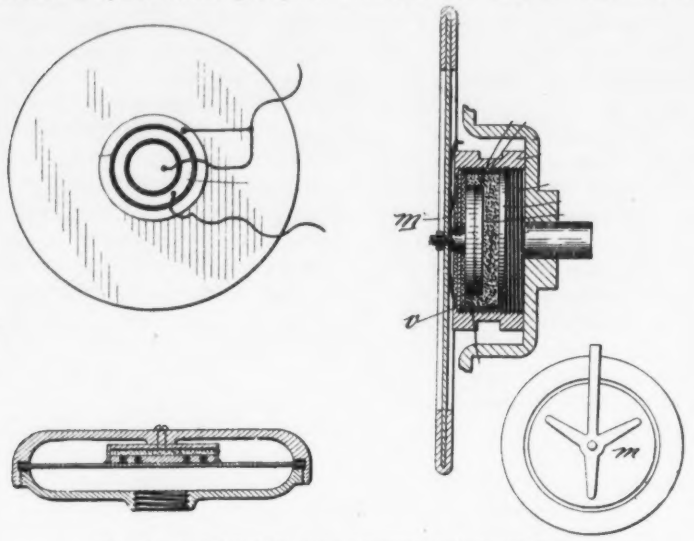


FIG. 2.—HUTCHISON AND CADDEN TRANSMITTERS.

an insulating support affixed securely to the diaphragm. In the figure the electrodes are shown as concentric rings, but other forms equally good readily suggest themselves. Between the electrodes insulation is placed and about them a closed chamber, partly filled with carbon granules is arranged. The electric circuit is led to the electrodes and is completed through the granule contacts, maintained by gravity. The variation of resistance necessary for transmission depends upon the pressure variation caused by the inertia of the particles, when the diaphragm vibrates.

Observing now Mr. Cadden's transmitter, the usual general arrangement of parts is adhered to, but the details of construction are novel. Instead of the usual flexible diaphragm joint of fabric or mica, between the movable electrode and carbon chamber, there is in this case provided a sliding joint. The head of the chamber is provided with an aperture and the spindle of the movable electrode slides in this, the joint being virtually packed to prevent the escape of the granules from the chamber proper into the space behind the electrode, by the use of the fabric packing disc, *V*. At *m* a second fabric disc is placed, outside the chamber, and the tripod spring, shown enlarged in elevation, resting with its center upon the diaphragm and its legs upon this external fabric, serves to maintain a sensitive, flexible connection between electrode and diaphragm.

Another attachment for transmitters for so holding a sheet of paper that it forms a germ-proof partition between telephone users and the infection supposed to exist in transmitter mouthpieces, is the subject of a patent issued to J. F. Logue. This latest attachment, the most compact for its purpose thus far seen, is a wire ring and clamp so designed that when the clamp is sprung over the base of the mouthpiece, the ring lying concentric with and in a plane parallel to the edge of the mouthpiece, forms therewith a channel of sufficient width to receive and hold the paper in position.

Still another patent relating to the transmitter portion of the telephone instrument is that bearing the title, "Coil-Box for Telephones," wherein is described a modification of that type of transmitter arm so familiar a few years ago when the magneto system was in vogue, having a receptacle or enlargement at its base in which the induction coil is mounted. The present modification consists in providing a base plate for such a transmitter arm and in so hinging the arm to the base plate that the former, normally held in position by a latch, may be swung aside to expose the induction coil to view. The theoretical advantages of this are without doubt very much greater than the real ones, for the necessity of access to the induction coils is rather remote. The possibility for a decided advantage does, however, exist in this transmitter arm in that the arm proper is made hollow, and therefore may be used to carry the transmitter cord concealed and not in a position to be toyed with by the telephone user. This point, however, is not mentioned in the present patent, which is granted to W. E. McCormick and assigned to the International Telephone Manufacturing Company.

A polarized bell is the subject of a patent granted to E. E. Yaxley and assigned to the American Electric Telephone Company. The novelty in this bell lies in the reversal of the customary positions of the armature and yoke piece. Thus, instead of the armature being placed between the poles and the yoke, this latter is perforated to admit the passage of the poles through it, and the armature is hung outside the yoke. The only advantage which can be claimed for this novel arrangement of parts is such additional rigidity as is imparted to the magnet by the poles being thrust through the yoke.

Of the remaining patents, both relate to intercommunicating systems; that is, telephone systems in which all switching is performed manually at the different stations. Both of these are so designed that it is possible for but two stations to be connected at one time, and therefore privacy is guaranteed. One of these systems is adapted to single wire, dial-switch working, while the second is for true metallic or balanced line working. Both systems are the inventions of Messrs. S. H. Parsons and T. Sloper, of England.

In the first system the completion of a connection is dependent upon the action of two relays, one at each of the stations to be connected, and which control receiver circuits of the respective stations. When one station desires a second the dial switch is first properly placed and a signal sent. In answering, the called station must hunt for the calling station by revolving his switch arm. When the correct point is reached, that of the calling line, this fact is indicated to both parties by the click coincident with the closing of the receiver circuits by the operation of the two relays. This desired result is accomplished by the arrangement of circuits shown in Fig. 3, from which it will be seen that in order to operate either relay, the switches at both stations must be properly set.

The second system depends upon maintaining the receiver and

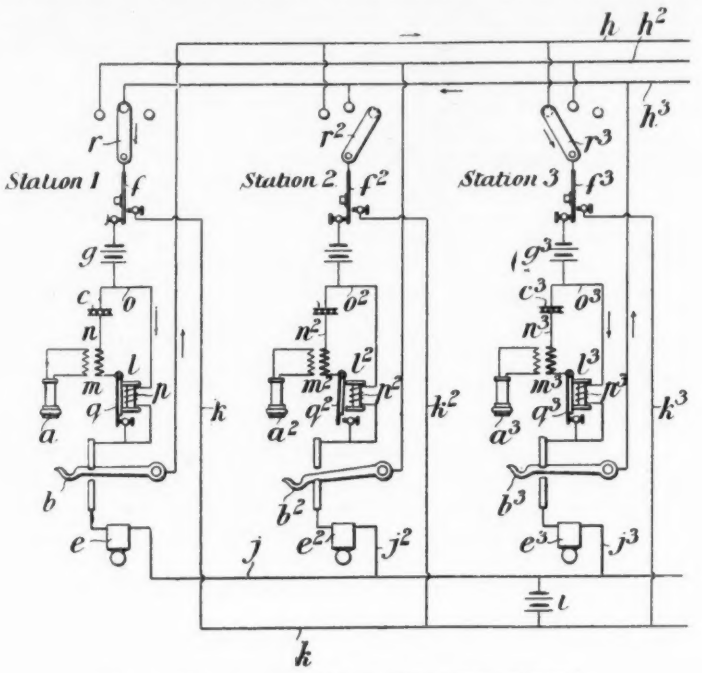


FIG. 3.—PARSONS AND SLOPER TELEPHONE SYSTEM.

transmitter circuits of each station entirely independent of each other, and yet so connecting both circuits to the lines that by the agency of plugs and jacks the transmitter circuit at one station may be directly connected to the receiver circuit of the one desired and vice versa. On receiving a signal, the desired station, as with the previous system, must hunt for the calling line and when he has found it the existence of his plug in his jack of that line, connects his transmitter to the distant receiver. Thus it is seen a completed connection depends upon the mutual actions of both calling and called stations toward the same end and privacy is therefore guaranteed.

Wireless Telegraph Message From President to King.

It is announced from the Marconi wireless telegraph station at South Wellfleet, Mass., that the following message was transmitted on January 19 by the Marconi system of wireless telegraphy between Cape Cod and Cornwall, England, from President Roosevelt to King Edward:

HIS MAJESTY, EDWARD VII,
LONDON, ENGLAND:

In taking advantage of the wonderful triumph of scientific research and ingenuity which has been achieved in perfecting a system of wireless telegraphy, I extend on behalf of the American people most cordial greetings and good wishes to you and to all the people of the British Empire. THEODORE ROOSEVELT.

WELLFLEET, MASS., January 19, 1903.

King Edward replied by cable as follows:

SANDRINGHAM, January 19, 1903.

THE PRESIDENT,
WHITE HOUSE, WASHINGTON, AMERICA:

I thank you most sincerely for the kind message which I have just received from you, through Marconi's transatlantic wireless telegraphy. I sincerely reciprocate in the name of the people of the British Empire the cordial greetings and friendly sentiment expressed by you on behalf of the American Nation, and I heartily wish you and your country every possible prosperity.

EDWARD R. AND I.

A great deal of secrecy has been maintained in regard to the Wellfleet station and the apparatus it contains; and it is reported in the newspapers that Mr. Marconi complains of the stealthy movements of spies and strange watchers in the vicinity. No technical data have been forthcoming, but a reporter of the *New York Journal* quotes Mr. Marconi as follows: "The severest part of my work at Glace Bay was the responsibility for so many lives while we were making our experiments," said Mr. Marconi. "A single mistake, the touching of a wire at the wrong moment, might mean sudden death. At Glace Bay we have a current of 100,000 volts. That is much more than we need, so here we use only 50,000 volts, but that is enough to kill a man, or a dozen men. Long-distance wireless telegraphy is simply a question of power, or rather a question of power combined with height of tower. The higher the tower, the less power is required. We have built our towers on this side as high as practicable in their exposed conditions, but we still have to use a current of very high potential energy."

The same reporter gives the following graphic description indicative of the amount of power used:

Mr. Marconi touched a lever. There was a blinding flash and a deafening report as a spark several inches long jumped from the disk at which the aerial wires conveyed to another disk connected with a wire leading into the ground. Although employees, officials and visitor alike had stuffed their ears with plugs of cotton wool, the sharp, explosive sound was painful in its intensity.

Crack! There was another flash as another spark jumped from one wire to the other.

"That was a dot," said Mr. Marconi. "A dash would be made by a longer interval between the electrical discharges. If our apparatus were properly adjusted that signal ought to be observed at our stations at Cornwall and at Cape Breton."

Some of the other newspaper reports speak of the blinding flashes of light seen in the Wellfleet building and the concussive discharges that literally shake the ground in its vicinity, and can be heard half a mile away.

The directors of the Marconi Wireless Telegraph Company of America held a meeting on January 20 and exchanged congratulatory messages with Mr. Marconi, who was then at Cape Cod. Only routine business was transacted, and further steps with a view to putting the wireless system on a commercial basis were discussed. "The possibilities, however," said John Bottomley, the manager of the company, "are practically illimitable. In sending the President's message from Cape Cod to Poldhu, only one-sixth of the available power was used, and I believe that right now it would be just as easy to send a message to New Zealand.

"The King's message was sent here by cable, as the apparatus at Poldhu is not sufficiently strong. Many new stations are contemplated, but on account of opposition I cannot make the plans public just now. Some of them, however, will be on the Pacific coast, and in time doubtless we shall have the world pretty thoroughly covered."

"There is already wireless communication between the Island of Santa Catalina on the California coast and the mainland, fifty miles distant. The intervening water is too deep for a cable, and previous to last summer, when the wireless system was inaugurated, communication between the island and the mainland was intrusted to carrier pigeons."

A dispatch from Wellfleet of January 20 says: "Signor Marconi continued his experiments with the station at Poldhu last night and received acknowledgment that the transmission was smooth, regular and satisfactory. He is now trying to ascertain the minimum of power required to propel vibrations across the Atlantic. He is using less than one-half the voltage employed in his earlier experiments at the Table Head station, and this afternoon he sent instructions by wireless to England that to-night he would try for results with less power than last night. Regarding the disturbances to the local telephone wires caused by the wireless experiments, Marconi said that all trouble could be remedied if the people who complained of interruptions would place an exhaust device on one of the telephone poles near the station."

CURRENT NEWS AND NOTES.

GERMAN AUTOMOBILE SPEEDWAY.—One feature of Emperor William's plans for transforming the Grunewald Forest into a great public park for Berlin is an automobile speedway seven and a half miles long and twenty-one yards wide.

THE TELEGRAPH IN CHINA.—The Chinese government recently confiscated the telegraph lines in that country, but by an edict the owners are given the option of retaining their stock. The management of the lines will reside in the government.

CHESS BY WIRELESS TELEGRAPHY.—A three-hours' chess tournament was played by wireless telegraph at sea last week, between teams on board the *Lucania* and the *Philadelphia*, the winners being on the latter ship, which was a good many miles from the other. The game went very smoothly.

CHICAGO DRAINAGE CANAL POWER.—The trustees of the sanitary district of Chicago have authorized their engineer, Isham Randolph, to advertise for bids to build hydraulic works at Lockport and at Joliet to make use of the power from the drainage canal for electric transmission. About 18,000 hp is available at Lockport, where there is a 32-ft. fall and 11,000 at Joliet, where the fall is 20 ft.

AN OCEAN EYE-OPENER.—A cable dispatch from Kiel, Germany, of January 13 says: The naval authorities here are making preparations to test Signor Pinos's hydroscope, by means of which, it is said, human eyesight is enabled to penetrate the sea to an incredible depth and for an enormous radius. A naval official who witnessed an experiment with the hydroscope in the Mediterranean says that the instrument can be operated from the deck of a ship, making visible cables, torpedoes, etc. It is said that the invention ought to nullify the dangerous character of submarine boats. The inventor is an Italian.

PENNSYLVANIA RAILROAD PLANS.—The Pennsylvania Railroad has given out more of its plans for the construction of its tunnel under the rivers. A commission of engineers is to design and supervise the construction of the tunnel. McKim, Mead & White, architects, are to have charge of the terminal structure; Westinghouse, Church, Kerr & Co., engineers, as already noted, are to have charge of the electrical and mechanical equipment, and the chief engineer's department of the Pennsylvania Railroad is to bring the lines of the railroad into and through the tunnels. The commission of engineers consists of Col. Charles W. Raymond, U. S. A., engineer of New York Harbor, chairman; Charles M. Jacobs, chief engineer of the North River section of the tunnel; Alfred Noble, chief engineer of the East River section; William H. Brown, chief engineer of the Pennsylvania Railroad Company, in charge of tracks and terminal yards; Gustav Lindenthal, Bridge Commissioner of New York City, and George Gibbs, first vice-president of Westinghouse, Church, Kerr & Co., in charge of mechanical engineering, electric locomotives and traction.

WIRELESS TELEGRAPHY IN CHINA.—It is proposed to establish the Marconi system of wireless telegraphy between Pekin and Taku.

TELEPHONES FOR GERMANY.—A cable dispatch from Berlin of January 17 says: "The Postal Department has ordered 20,000 American automatic telephones as the result of experiments, which have turned out successfully. The ammunition factory at Karlsruhe has bought the patent rights." The name of the American maker is not given.

THE TOWN OF SPRAGUE, CONN., is promised an electric company for power, light, electric railway work, etc. This has a very fair and pleasing sound, for if any place in America has a right to electric power, etc., it is surely the one bearing the name of Sprague. The special appropriateness of the plan ought to remove any obstacles from its way, and the installation ought to be the very best of its kind.

CANADIAN NIAGARA POWER.—The Ontario Power Company promises delivery of electrical energy from Niagara Falls in Toronto, Ont., by the end of 1903. The company by that time, it is stated, will be in a position to furnish Toronto with about 15,000 hp, and if more is needed it can be had. A double-pole line will be built from Niagara to Toronto, so that, in the event of one line being disabled from any cause, a second line will be available. The company will eventually develop 150,000 hp.

MERCURY VAPOR LIGHTING.—An interesting dispatch from Schenectady, in the *New York Sun* of January 18, describes work that Mr. C. P. Steinmetz is doing in following up the line of investigation pursued by Dr. Arons, of Germany, on mercury vapor lighting, and confirming the ideas and data given through our own pages to the public by Mr. Peter Cooper Hewitt, whose pioneer work in this field has attracted so much attention all over the world. It is stated that the light as developed by Mr. Steinmetz is now used in that engineer's famous house for his laboratory and conservatory, where the latest novelties of electrical science dispute the visitor's attention with rare plants and tame alligators.

RAILS AS TELEPHONE CIRCUIT.—It is stated that experiments were made last week on the Dedham branch of the New York, New Haven & Hartford Railroad by a representative of the American Telephone & Telegraph Company in telephoning between stations, utilizing the railroad tracks instead of a line of wire for the transmission of messages. Telephones were placed in the stations at Roslindale, Highland and Dedham and connections made with the rails. The experiments were quite successful, except when cars on the local electric street railway crossed the overhead bridge of Beach Street, when the voices at the telephone became indistinct because of a "leak" on the electric car line. The New Haven company is said to be considering the advisability of equipping all of its stations with telephones if the telephone company can make its instruments work successfully.

NERNST LAMP GLOWER.—In a patent issued January 13 to M. W. Hanks, it is stated that if a Nernst lamp glower made in accordance with current practice is used on a direct-current circuit, the potential difference between its terminals and also its candle-power are usually found to be variable. When new there is a substantially uniform degree of light emission throughout its entire length, but gradually the portion next the negative terminals decreases in brilliancy until it becomes entirely non-luminous; and as the length of service increases the dark portion increases in length. While this change is in progress the current taken by the glower will generally vary to a greater or lesser extent and either the life of the glower is shortened or its efficiency is decreased. To remedy this defect the patent provides that a glower intended for use on direct-current circuits shall be first heated to conducting temperature and then subjected either to a normal or an overload alternating current for a comparatively short time. This treatment results in a minimum variation of potential difference and candle-power.

THE STEVENS INSTITUTE OF TECHNOLOGY.—A series of interesting events in connection with the formal inauguration of Mr. Alexander C. Humphreys as president of the Stevens Institute of Technology, Hoboken, N. J., will take place on February 4th and 5th. On the evening of Wednesday, February 4th, there will be held in the Carnegie Laboratory of Engineering a reception given by the alumni to President Humphreys. This will take the place of the usual mid-winter meeting of the Alumni Association. On Thursday, February 5th, at 2 o'clock, the inauguration ceremonies will be held in the Carnegie Laboratory. At 7 P. M. there will be a reception and dinner, tendered by the alumni, at Sherry's, Forty-fourth Street and Fifth Avenue, New York City. Many distinguished guests are expected to be present at this dinner. Those of the alumni who remember the dinner given celebrating the twenty-fifth anniversary of the Stevens Institute, which was held a few years ago at the Waldorf, and the more recent dedication of the Carnegie Laboratory of Engineering, will know what to expect at the forthcoming dinner. Acceptances have already been received from the presidents or other representatives of many leading universities and technical institutions of the East.

BRADLEY ALTERNATOR.—Two further patents were granted January 13 to Charles S. Bradley on his system of alternating-current generators, the peculiarity of which is that the alternator has not a separate exciting winding. The machine is of the induction generator type, the driven part having short-circuited windings. The stationary part has a distributed winding and in case it supplies three-phase currents, is tapped at three equidistant points by the working circuit, and at three other equidistant points midway between the above by the exciter circuit. In the exciting circuit are condensers, which have such capacity with respect to the inductance of the alternating circuit that they will supply magnetizing current of proper phase. The short-circuited element of the alternator is driven above synchronism with relation to the rotary field, and may be cut into a distribution circuit supplied by another generator without the necessity of bringing the two generators into synchronism. The present patents refer to details of the exciter element exterior to the alternator, and relate to such a selection and arrangement of the condensers that a small exciter of low e.m.f. may be employed. The exciter circuit being resonant or approximately so a large magnetizing current will flow in the rotary field winding. Another patent relates to means whereby a single exciter may supply a number of alternators. The applications for both the above patents were filed June 22, 1896.

LETTERS TO THE EDITORS.

The Making of Electrical History.

To the Editors of Electrical World and Engineer:

SIRS: I have been a constant reader of your valued paper for some years past, and I cannot refrain from writing to congratulate you upon the important article published in the January 17th issue on the Cooper-Hewitt Static Converter. I believe in newspaper work, when you get a good "story" exclusively for your own paper you make what you call a "scoop." This is certainly a genuine "scoop," and I am glad to see that the great metropolitan daily papers have recognized it and given you due credit for it.

Speaking of "scoops," I notice in the same issue of your paper that you have an editorial entitled "Telegraphic Anec-dotage," which refers to the fact that one of your esteemed contemporaries recently went up in air over the discovery of Mr. Morse's diary and a wonderful prophecy contained therein. The diary never having been lost, and its contents or most of it having been published over and over again, and the prophecy having appeared in the book published by Prime twenty-five years ago, there was not very much cause for elation over the "discovery" (?), and certainly no excuse for the flourish of trumpets which accompanied it. I realize the delicacy of your position in referring to this matter, but like every fair-minded man I am glad always to see this sort of thing cleared up, and I wish to congratulate you upon the exposé you make. Trusting I have not trespassed too much upon your valuable time, I remain,

NEW YORK CITY. CHARLES HERMAN.

Electric Roads in Sweden.

To the Editors of Electrical World and Engineer:

SIRS: As to the adoption of electric traction on the government-owned railroads of Sweden, Mr. J. Gust. Richert in a letter to me,

dated Stockholm, December 19, 1902, states the following, according to an interview with Mr. Nördstrom, general director of the Swedish royal railroad direction:

"The question is at present being energetically pushed. In charge of the investigations is Mr. R. Dahlander (at present with the 'Allmänna Svenska Elektriska Sktiebolagct i Vesterås'), who from January 1st is engaged by the railroad direction for the study of electric railroad traction. Monday, December 22, he is to submit his report, as well as the reports of the State's peat engineer and myself as to the use of the turf pits (in south Sweden) and the waterfalls, for motive power. Further than this the question has not yet gone, and the rumors seen in the press have probably their origin in Mr. Dahlander's inquiries addressed to several firms."

NEW YORK CITY. ARVID WESTERBERG.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Direct-Current Dynamo Design.—DAVIES.—An article on some special points in direct-current dynamo design. The drum armature is superior to the ring type for several reasons; the toothed drum core affords the economy that the length of the air-gaps is reduced, thus requiring a smaller number of ampere-turns on the field magnet; in a toothed armature machine, the commutation is improved by working at a high induction in the armature teeth; this is owing to the armature reaction being reduced. High induction in the teeth may be obtained by making them narrow; but the hysteresis and eddy current losses are thereby increased with the result of undue heating of the core; but it is not necessary to reduce the section of the teeth in order to minimize armature interference; this result may be attained equally well and without those disadvantages by simply increasing the length of the air-gaps. In an open type machine it pays to provide means for ventilating the armature, but in an enclosed machine the introduction of ventilating ducts in the armature does not materially reduce its temperature. The number of poles of the field magnets is important; an increase in this number permits a decrease in the length of the air-gaps and a corresponding reduction in the size of the magnet and in the number of ampere-turns on it; moreover, the armature of a multipolar machine offers better facilities for ventilation than does the armature of a bipolar machine; the limit of the number of poles is, however, given by the hysteresis and eddy current losses in the armature and by the cost of manufacture. The use of non-concentric poles prevents distortion of the field and therefore improves the commutation. The yoke ring of a magnet of the iron-clad type, if of the same material as the cores, should be one-half of the cross-sectional area of one of the cores, or, if of different material, should be of sufficient area to carry one-half of the lines of force carried by one of the cores. It is well to make the carcase of a motor sufficiently large to allow ample room for attending to the brushes and the brush-holders, even if the machine has to be made somewhat larger in consequence. The cost of labor is comparatively high and the cost of material low in small machines; the smaller sizes of machines should, in order to attain the maximum economy, be designed so as to necessitate as little labor as possible, even at the expense of material. The larger sizes of machines should have as simple castings as possible and should be made of a large number of different parts.—Lond. *Elec. Rev.*, December 19.

LIGHTS AND LIGHTING.

Nernst Lamp.—BOSE.—An account of an experimental investigation of the behavior of the Nernst lamp when worked with direct current. In this case electrolysis sets in, and under favorable circumstances the products of this electrolysis may be isolated. At the same time, the space around the pencil is filled with an extremely bright blue light; he agrees with Stark that this light is due to metallic vapor. It ceases in a few seconds when an alternating current is substituted and the electrolysis also ceases. When direct current is used, metal is deposited at the negative pole and this gives rise to branch currents having some analogy with the blue flames in incandescent lamps. The author also investigates the behavior of non-metallic bodies as cathodes, in vacuum tubes, thinking that "with such electrodes the anode rays should behave like cathode rays from metals; selenium and tellurium, however, behave just like metals; lead peroxide does not emit cathode rays when used as a cathode."—*Ann. d. Phys.*, No. 13; abstracted in Lond. *Elec.*, January 2.

POWER.

REFERENCES.

Power Plants.—The whole issue is devoted to illustrated articles on power plants. Among them are special articles on various details of steam engine and boiler practice and descriptions of the power plants of the Boston Elevated Railroad, the Metropolitan Railway, of Paris; the Berlin Electric Railway, the power transmission at Kalgoorlie, Australia; the Rand Central Electric Station at Johannesburg, Transvaal; the power plants of the Milano-Gallarate-Porte Ceresio Railway; also articles on special points of hydraulic power generation, with descriptions of hydro-electric plants in California and in Switzerland.—*The Eng.*, January 1.

Governing of Engines for the Parallel Operation of Alternators.—DE MARCHENA.—His very long paper in full, an abstract of which was recently noticed in the Digest.—*Bull. Soc. Int. des Elec.*, November.

TRACTION.

Long-Distance Electric Railroading.—LOUIS DUNCAN.—A lecture in which he discusses the difficulties of the problem of applying electric power on railroads at present operated by steam locomotives. The conditions are entirely different from those of the tramway and suburban railway; for through passenger service a single car, or even two cars, are not enough to give the comfort to which the traveling public is accustomed; this requires heavy trains consisting of a number of cars. 500 to 600-volt direct-current motors, receiving current either directly from a central station or from sub-stations, are not applicable. The possibilities of congestion of traffic especially of freight congestion, make the capacity of sub-stations enormous as compared with the average power required on the line, and there is required in addition an immense amount of copper for the feeders. Another difficulty is the large amount of switching to be done, much of it of a complicated nature. If electricity is to be used in terminals and freight yards, a locomotive must be designed which is economical at all speeds and which is under perfect control, and current must be supplied to these locomotives by some means which will not endanger the lives of the train hands. He then discusses the use of alternating currents for traction. "The roads in Switzerland show practically nothing except that a three-phase alternating motor can drive a car—a thing which was very well known before. There is no railroad problem involved in their operation. The cars are small and the voltages used are in no case above 750 volts." Regarding the Lecco three-phase railway in Italy, he says that the Ganz Company has had difficulties which are shown to be serious by the fact that the company is over a year behind the proposed date of operation. "The service required is not the heavy service that we need in our railroads, and if it was, the great uncertainty of operation that has been shown would make the system impossible of operation." A great and almost fatal difficulty with such a scheme is said to be in the liability of trouble with overhead wires. "A two-track system, with four wires overhead, these wires having a great difference of potential between them, is almost certain to cause trouble even on a straight track, and when there is switching the complication becomes enormous." Concerning the system of the Oerlikon Company (described in a paper by Haber, which was abstracted at length in the Digest) he says that it has some advantages in that it requires but little trolley wire over the track and affords an excellent means of regulating the motors. "Its disadvantages lie in the fact that it interposes between the trolley and the motors a transforming station which is not only expensive, but adds greatly to the complexity of the

system." For heavy railroad work, between this and the three-phase system, he would unquestionably choose the Oerlikon method. Concerning Arnold's proposition, he says it affords "an ingenious, if doubtful, solution of the railroad problem," but he is afraid that its complexity will prevent its adoption; "without going into any particular reason why, it does not sound like an operative system." The Westinghouse system is said to promise much in the way of simplicity and applicability to the heavy problems of steam railroad traffic; a series motor has the advantage that it is to a certain extent self-regulating. One disadvantage is in the low period which will require large static transformers; but if this is the only difficulty, it may be overlooked.—*Tech. Quart.*, December.

REFERENCES.

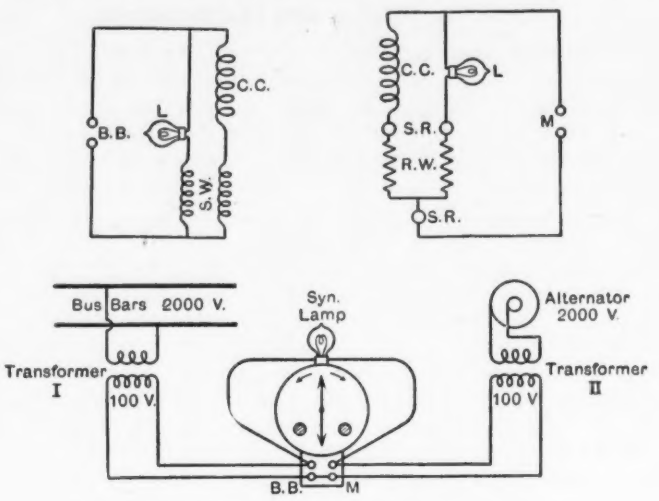
European Tramways.—An article in which the possibilities for capital investment in European tramway enterprises is discussed.—*St. R'y Jour.*, January 3.

Municipal Ownership.—DONALD.—The first part of an article in which he denies that municipal tramways and other municipal enterprises have proved a failure in Great Britain. He acknowledges that his arguments apply to British conditions only.—*St. R'y Jour.*, January 3.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Central Station Statistics.—A long statistical article with numerous tables and diagrams, on British central station costs in 1900 and 1901. The municipal stations are first discussed. The Bolton station has given the best results in showing lowest total costs simultaneously with the lowest relative capital expenditure; the city is favorably situated for cheap fuel and a large proportion of the output is supplied for traction purposes; the center of the town is served by direct current on the three-wire system, with a pressure of 460 volts between the outers; the outlying districts are served by single-phase, alternating current at 2,000 volts, transformed down to 100 and 200 volts by transformers in houses and sub-stations; the station has been in operation for seven years; for this plant the total cost per unit sold was 1.92 cents in 1901, and the total cost plus 6 per cent. of the mean expended capital per unit sold was 3.46 cents in 1901. The same values for the average of all municipal stations discussed were 3.90 cents and 7.36 cents. Other interesting averages are those showing the actual prices of supply per unit; the mean price to ordinary consumers for lighting and power supply was 8.32 cents in 1900 and 8.12 cents in 1901; for public lighting the price was 4.66 cents in 1900 and 4.72 cents in 1901; and for traction supply 3.52 cents in 1900 and 3.36 cents in 1901; the average total receipts for current for all uses was 7.12 cents in 1900 and 6.78 cents in 1901. The average figure representing 6 per cent. of tbe mean expended capital per unit sold, is very nearly equal to the total cost per unit; in other words, of the total charges on the revenue of a concern, half is roughly the total working cost and half the capital charges. The variation of the various items of cost during the last seven years is plotted diagrammatically. Diagrams are also given showing the influence of output and load-factor on costs of working; below one and a half million units the output is the most governing factor, while above that output the load factor becomes comparatively more and more important in its effect on the expenses, especially on the capital expenses. Company undertakings are then discussed; the St. James station heads the list again, as in former years; here the total cost per unit sold was 4.18 cents in 1901, and the total cost plus 7 per cent. of the mean expended capital per unit sold 6.52 cents. The corresponding figures for the average values of all the stations are 5.42 cents and 12.02 cents. Curves are given showing the variation of the average values in the last years; the curve of total revenue is everywhere below the curve of total costs plus 7 per cent. of the mean capital, and since 1897 the former curve has fallen more rapidly than the curve of total charges, so that in 1901 the difference between these two values was 2.2 cents per unit. The final conclusion is that the total revenue from all sources was equal to the total costs plus 5.3 per cent. of the mean capital in the case of municipal concerns, and in the case of companies to the total costs plus 4.7 per cent. of the mean capital expended—Lond. *Elec.*, January 2.

Paralleling Alternators.—An illustrated description of a "rotary synchronizer" used at the Hastings station which is essentially a two-phase motor consisting of a laminated core running in ball bearings and carrying a pointer; this core is wound with an ordinary two-phase winding connected to three slip rings; outside the rotor is the laminated stator, which is likewise provided with a four-pole, two-phase winding. In the case of both rotor and stator, one circuit is connected across the full voltage with a lamp in series with it, while a choking coil is inserted in the other; thus two rotary fields are produced, and the connections are such that they rotate in the same direction; obviously they will tend to rotate "in step." The connections of the stator are shown in Fig. 1 and the connections of the rotor with the incoming machine in Fig. 2; Fig. 3 shows the total arrangement. *B B* are the terminals connected to the busbars, if necessary through a transformer; *M* are the terminals connected to the incoming alternator, if necessary through a transformer. *L* is a lamp forming a non-inductive resistance, *C C* are choking coils, *R W* is the rotor winding, *S W* the stator winding and *S R* slip rings and brushes. The action is as follows: If the frequencies in both circuits are the same, the two fields will be rotating at the same speed and the motor will stand still. If on the other hand the frequency—i. e., the speed of rotation of the stator field—is

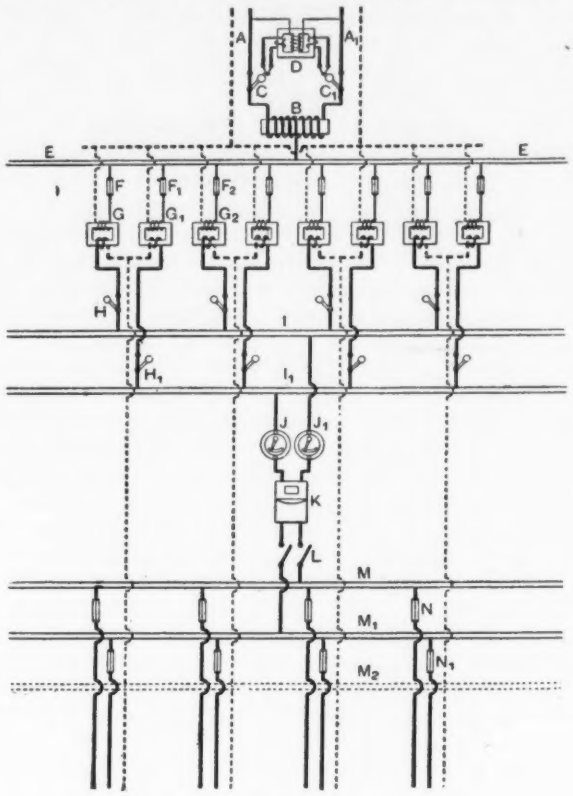


FIGS. 1, 2 AND 3.—PARALLELING ALTERNATORS.

greater than that of the rotor, the latter will have to revolve in the same direction as the flux in order that the two fields may keep in step. Thus, for example, a clockwise rotation will show that the frequency of the incoming machine, and therefore its speed, is too great, while a counter clockwise rotation will show that it is too small. The speed of rotation is an indication of the difference between the two frequencies, one complete revolution representing a difference of two cycles. Another important feature is the arrangement of two lamps, a red one and a green one, which are automatically exposed to view according to the direction of rotation of the spindle; the result is that the engine driver can see from a considerable distance whether his machine is going too fast or too slow. The whole apparatus is surmounted by an ordinary synchronizing lamp, as a guide to the engine driver. The switching in or out of the colored lamps is accomplished by means of a small lever which is carried friction-tight on the spindle and actuates a two-arm shutter.—Lond. *Elec.*, January 2.

Line Protection Devices.—An illustrated article on some experiments made at the Hastings electricity works before invited engineers. A demonstration was given of short-circuiting a high-tension feeder by driving a nail into it midway between the generating station and the sub-station, which are about 1½ miles apart. The feeder in question was duplicated and worked in conjunction with a "discriminating" transformer and choking coil, the arrangement being shown by the adjoining diagram of sub-station connections. The secondaries of an auxiliary transformer, *D*, are short-circuited by copper fuse wires which support the weighted levers that tend, when released, to disconnect the respective feeders from the choking coil, *B*; the high-tension primary of this transformer is connected between the duplicate feeders. Under normal conditions there will be no difference of pressure across the terminals of either secondary winding, but should a feeder fail, current will flow from the healthy feeder to the faulty feeder through the primary winding of this transformer, and the construction of the transformer is such that a heavy current will be induced only in the secondary supporting the weight of the switch controlling the faulty feeder. In the diagram *A* and A_1 are the high-tension feeders supplying the sub-station; *B* is the "discriminating choking coil"; *C* and C_1 are switches for disconnecting either feeders; *D* is the "discriminating transformer" for

operating these switches; *E* are high-tension busbars; *F* F_1, etc., high-tension fuses; *G*, G_1, etc., 20-kw transformers; *H* and H_1 low-tension "discriminating cut-outs"; *I* and I_1 low-tension busbars; *J* and J_1 main ammeters; *K* main three-way wattmeter; *L* a double-pole main switch for disconnecting secondaries of transformers from the distributing busbars, *M* M_1 and M_2; *N* and N_1 are fuses on distributors. The arrangement was shown to give absolutely satisfactory results. Among other things it was shown that the duplicate feeders cannot be satisfactorily protected by fuses alone; the discriminating choking coil was left open-circuited, and the feeders were paralleled through fuses at both ends of the line; if both lines were protected by fuses of equal sectional area one of the fuses on



LINE PROTECTION DEVICES.

the healthy line must have blown before the fuse on the distributing end of the short-circuited line, as these fuses have to carry any load on at the time, in addition to the current necessary to blow the fuse of the disabled feeder, consequently a short-circuit on either of the duplicate lines is bound to interrupt the supply; and this was shown to happen. The fuses at the distributing end of the line were then removed and the switches connecting the lines through the "discriminating choking coil" were closed, as shown in the diagram. If either line is earthed while the other line is maintained at approximately 2,000 volts above earth, a sufficiently heavy current to instantly blow the fuse controlling the switch on the end of the faulty feeder, is induced in the secondary to which this fuse is connected.—Lond. *Elec.*, December 26.

REFERENCE.

Regulating Rheostats.—KOENIG.—An article on the calculations of adjustable resistances. He describes a graphical method which enables one to follow the calculation in a very simple way and to find out the influence of the various determining factors.—*Elek. Anz.*, December 21, 25.

WIRES, WIRING AND CONDUITS.

Economizing Wire in House Wiring.—TATLOW.—An abstract of a brief paper read before the Dublin section of the (Brit.) Inst. Elec. Eng., on a modified system of house wiring as an improvement on the "looping-in system." The looping-in system of wiring avoids all joints in the circuit, connections being made only at the switches, ceiling roses and fuse boards; it involves in certain cases the use of an excessive quantity of wire which not only increases the expense, but also the voltage drop on the more distant lamps. In the author's system, as ordinarily used, a wire is carried from one pole to the fuse-distributing board through one terminal of all the ceiling roses of a group of lights, and the wire from the other pole is carried from switch to switch, the remaining terminal of each ceiling rose being fed by a separate wire from its own switch. This system involves three wires, being carried down to each switch when the switches are not arranged in groups, and it also involves the whole current being carried up and down to each switch. By the use of ceiling roses with three terminals, it is possible to carry both wires from the fuse board through from ceiling rose to ceiling rose, and to take a feed for one switch off one terminal and to bring the switch wire back to the third terminal, the lamp being connected to the other side of the circuit. Using this system, only two wires are required between the ceiling rose and switch, and these need only be large enough to carry the current for the one point. Moreover, the length, and therefore the drop on the main circuit is reduced.—Lond. *Elec.*, January 2.

REFERENCE.

Fuses.—SACHS.—A well illustrated Franklin Institute paper on safe and accurate electric safety fuses, their evolution, principle, operation and application. He showed striking experiments in which plain wire fuses and enclosed fuses of the same capacity were blown. While the blowing of the plain wire fuses produced a blinding flash and loud report, the blowing of the enclosed fuses was scarcely noticeable and was neither accompanied by a report nor by flash.—*Jour. Frank. Inst.*, January.

ELECTRO-PHYSICS AND MAGNETISM

Formation of Ozone.—WARBURG.—An investigation of the electric discharge producing ozonization in a closed volume of oxygen. The formation of ozone then has a limit varying with the conditions of the experiment. There exists besides the ozonizing effect a contrary effect which counterbalances it after a time; it is the electric discharge itself which produces this contrary effect. He endeavors to obtain a measure of both effects. The maximum percentage of ozone is about three times as high for negative as it is for positive discharges; the decomposing activity is the same for positive and negative electricity; the effect of temperature on both discharges is the same.—*Ann. d. Phys.*, No. 12; abstracted in Lond. *Elec.*, December 19.

Magnetization of Liquids.—PIAGGESI.—An account of experiments in which he endeavored to decide the question as to whether the magnetic susceptibility of liquids changes with the temperature. The demagnetization of water decreases as the temperature rises in a linear manner; there is a distinct influence of the temperature, although only a small one. The magnetic susceptibility of a solution decreases as the temperature rises. The temperature coefficients are nearly the same for all solutions studied, including nickel chloride, cobalt chloride, manganese or iron chloride, sulphate and nitrate, and are of the same order as the coefficient of expansion of a gas. The product of the magnetic susceptibility into the absolute temperature is a constant whose value depends solely upon the nature and the concentration of the solution, in accordance with the law discovered by Curie for oxygen and for an aqueous solution of ferrous sulphate. The product diminishes as the solution becomes more concentrated.—*Nuovo Cimento*, October; abstracted in Lond. *Elec.*, December 26.

ELECTRO-CHEMISTRY AND BATTERIES.

Conversion of Amorphous Carbon to Graphite.—FITZGERALD.—A Franklin Inst. paper giving an interesting critical summary of the systematic work done in this direction by various investigators, notably Despretz, Berthelot, Moissan and Acheson. By the Acheson process the conversion of amorphous carbon into graphite is complete; the density is thereby increased considerably, the mean value of densities of six electrodes before graphitizing being 1.90 and after graphitizing 2.19; the electric conductivity is at the same time greatly increased; Lincoln found it to be increased four times. The purity of the graphitized carbon is greater than that of the amorphous from which it is made, for a greater or less quantity of the contained impurities is volatilized. In summarizing the more important work done by the various investigators, the author remarks that their results are by no means in agreement. The conclusion to be drawn from a comparison of Berthelot's and Acheson's researches seems to be that while all true graphites yield graphitic oxide, all bodies yielding that compound are not necessarily graphites suitable for practical purposes. In view of the fact that various kinds of hard and soft graphites produced by artificial means are now being put on the market, and that varieties of amorphous carbon (notably retort carbon) are also sold under the name of graphite,

the author thinks it would be advisable to revise the nomenclature of carbons, reducing it to a more rational and practical form free from all ambiquities.—*Jour. Frank. Inst.*, November.

Solubility, Electrolytic Conductivity and Chemical Action in Liquid Hydrocyanic Acid.—KAHLENBERG AND SCHLUNDT.—An account of the investigation of the electrical conductivity of solutions in liquid hydrocyanic acid, which is of special interest because this solvent has a high dielectric constant, rendering an exact examination of the Nernst-Thomson rule possible. While some salts dissolved in liquid H C N conduct electricity better than in water, many others have a much higher resistance than in their corresponding aqueous solutions. In the face of these facts, the Nernst-Thomson rule can clearly not be considered as substantiated by the conductivity of solutions in liquid H C N. The authors conclude that the conductivity of a solution is not determined by the dielection constant of the solvent, its state of polymerization or its spare valences, but rather by the specific nature of the compound formed when solute and solvent act on each other to form the solution.—*Jour. Phys. Chem.*, October.

Influence of the Solvent in Electrolytic Conduction.—PATTEN.—A long account of an investigation the principal results of which are: that the lowering of the specific electric conductivity of non-aqueous solution by addition of a pure solvent is approximately proportional to the number of gram-molecules of solvent added and depends also on the solvent; the application of this principle offers a new method of molecular weight determination; that electrical conductivity is probably the resultant of the tendency of some molecules to transfer the charge produced by an impressed e.m.f., and the resistance offered to this transfer of charge by other molecules; that Konowalow's conclusion that the small molecular volume of water stands in a definite relation to the power of aqueous solutions to conduct electricity is unwarranted; also his conclusion that the magnitude of the electrical conductivity of solutions is proportional to the intensity of chemical combination between solvent and solute as measured by the heat effect.—*Jour. Phys. Chem.*, November.

Alloys of Lead, Tin and Bismuth.—SHEPHERD.—An account of a very long experimental investigation of the alloys of lead, tin and bismuth, with reference to the principles of physical chemistry, especially the phase rule. From alloys containing lead, bismuth and tin, the tin pure crystallizes, but often in an unstable, denser form. Lead and bismuth form two series of solid solutions, in each case with contraction. When the fused alloys are cooled fairly rapidly, the saturation concentrations are not reached.—*Jour. Phys. Chem.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

"Quantometer."—An illustrated description of what he calls an "electric quantometer." The measurement of induction in large masses of iron by the ballistic method is rendered difficult owing to the gradual character of the growth or decay of magnetism following the application or suppression of the magnetizing force and the consequent "tailing off" of the induced current in the exploring coil. The quantity of electricity to be measured is thus conveyed by a current lasting, perhaps, 30, 60 or even more seconds, and the use of an ordinary ballistic galvanometer is entirely out of the question. His "quantometer" is designed to take the place of the ballistic galvanometer and to do what it fails to do, i. e., to sum up in a single throw quantities conveyed by currents lasting an appreciable time. It is said to be useful for flux-measuring work in connection with dynamos, etc. The principle is to use a moving coil, shuntless ammeter with a coil which is wound as usual, on a closed metallic frame to secure strong electromagnetic damping, and to replace the controlling springs by similar ones made so weak as to exert an inappreciable controlling force; springs of the phosphor bronze strip type as used for galvanometer suspension, are said to serve excellently. As a result the coil will remain permanently in whatever position it may be placed, and if the quantity to be measured be passed through it, it will move forward into another position and remain there, the regular distance moved over being a measure of the quantity. He gives a theory of the instrument, based upon the fundamental equation which states that the instantaneous value of the driving couple is equal to the sum of the instantaneous values of all the resisting couples. The latter are the couple producing angular acceleration of the moving coil, the couple due to air resistance, the couple set up as a result of the induced current produced in the coil due to its motion, the couple due to the current induced in the metallic frame on which the coil is wound, and the couple due to pivot friction. He shows that the throw is strictly proportional to the quantity only when the pivot friction is entirely absent or the discharge instantaneous. But as a small amount of pivot friction is unavoidable, the indications in an actual instrument fall off as the duration increases, and a correction has accordingly to be applied. An instrument for laboratory use and a portable instrument are described.—Lond *Elec.*, December 26.

REFERENCES.

Phase Meter.—JOHONNOTT.—An illustrated description of an alternating-current phasemeter which he was constructing for the use of students in the laboratory, after the pattern of Lord Rayleigh's instrument.—*Phys. Rev.*, November.

Magnetic Measurements.—ARMAGNAT.—A very long illustrated paper, read before the Internat. Soc. of Elec. in Paris, in which he describes the industrial methods of making magnetic measurements.—*Bull. Soc. Int. des Elec.*, November.

Localizing Faults.—JANET.—A brief paper in which he describes a method and illustrates the connections by diagrams, for localizing a fault in an underground three-phase cable.—*Bull. Soc. Int. des Elec.*, November.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Selective Wireless Telegraphy.—BULL.—A long, illustrated description of a system which is based entirely on mechanical principles. Instead of using simple wave impulses in transmitting signals as by other systems of wireless telegraphy, a series of a fixed number of wave impulses, succeeding each other at pre-arranged short intervals of time, is used, and thus it is possible to give the signals from each separate transmitter a distinctive feature of their own. For instance, if each series consists of five impulses there are four intervals between them and any values may be given to these four intervals; the variation of these intervals seems to be the fundamental requirement; it is evident that it is easy to produce a great variety of series; the receivers at the different receiving stations are tuned to these lengths of the intervals. The conversion of the Morse signs into such a series of intervals at the transmitting station, as well as the reconversion of the series into dots at the receiving station, is accomplished automatically by two instruments, the "disperser" and "collector" respectively, which are described. Sending is carried out in the usual way by pressing down a Morse key for short or long periods. The system is said to work remarkably well in the laboratory. In an editorial discussion which is rather favorable, it is said that one defect, common to all modern telegraph systems, remains, namely, the ease with which the receiving station can be incapacitated, an unbroken succession of impulses in the neighborhood of the receiving apparatus being quite sufficient for this purpose. Another difficulty is that the "dispersers" must revolve synchronously with one another; the greater the number of stations, the greater is this difficulty. Finally the speed of transmission appears to be low.—Lond. *Elec.*, January 2.

New Book.

THE TOWN TROUBLE. By Adolph F. Hamacek. Sturgeon Bay, Wis.: Adolph F. Hamacek. Price, $1.00.

A lucubration on wattmeters by a Western author noticed in these columns some months ago appeared to the reviewer to have touched the depth of worthlessness, but the present publication—it cannot be dignified with the name of book—reaches still a lower level. Its only claim to notice aside from its most absolute worthlessness, is as a gem of the "English as She is Wrote" class of literature. As a specimen of book making, the thing is also a curiosity. The binding is apparently home-made, and the letter press is only on one side of a sheet, probably to eke out the slim text, which occupies less than 20 miniature pages, and would scarcely fill three columns of this journal. And what a text! As usual with this type, there is a portrait frontispiece of the author and some opening pages of "fine writing" of which the following is a specimen: "It heeds not the effect or result whether it raptures the heart with joy or whether it rends it with grief, no matter by whom it is sent; by pirate or king."

Subtracting the verbosities of the practical man who turns author, the equivalent of about a half column of the matter appears to be devoted to meter wiring, but what it is all about would baffle a Bacon-Shakespeare expert turned electrician. Aside from the ludicrous nature of the contents, to offer such a piece of book-making at a price of one dollar is nothing less than an attempt to obtain money under false pretences.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23rd, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

Bituminized Fibre Conduit.

The American Conduit Company was recently formed to take over the business formerly conducted by the Electrolysis Proof Conduit Company of Chicago and the Asphalt Paper Pipe Company, of Los Angeles. Both of these companies have done an extensive business in their respective territories in the past in bituminized fibre conduits for underground electrical work. In addition to the Chicago and Los Angeles factories, a large plant for the manufacture of these conduits is just being completed at Chester, Pa., and a Philadelphia office will be opened.

This conduit is made by rolling paper which has been passed through hot asphalt, on to a mandrel, making a pipe which is a combination of paper fibre and asphalt, and which is absolutely waterproof and a remarkably good insulator. The pipe is made in seven-foot lengths and joined together with a machine-fitted, countersunk slip joint dipped in hot asphalt just before joining. This makes a conduit practically water-tight from end to end. This conduit has been used with great success around Los Angeles, not only for conduit duct but for conducting irrigating water, as it will stand low water pressures continually and very high pressures for a short time. The conduit itself is a very good insulator and will puncture only at extremely high voltages.

It has been the standard in underground construction of the Pacific States Telephone & Telegraph Company for its conduit in all the large cities of the Pacific Coast, and has now been adopted by the Chicago Telephone Company. Tests made several years ago in Oakland, Cal., under identical conditions on terra cotta conduit and bitumenized fibre showed a large amount of electrolysis on the cable sheath in the terra cotta duct and practically none in the bituminized fibre. The lightness of the duct in addition to saving transportation charges makes it cheaper to lay because of the rapidity with which one man can handle long lengths. Another practical advantage with this conduit is the accuracy of the alignment at the joints and the smoothness of the surface presented for the drawing in of a cable. Although the conduit is very tough, it has no sharp fins or edges and there is nothing in its composition that is hard enough to injure the lead when the cable is being drawn in. Although somewhat higher in first cost at the factory than vitrified tile conduit, the weight per lineal foot of duct is so much less that for shipments to any distance bituminized paper is cheaper because of the saving in freight. This form of conduit originated in Los Angeles, and the patents owned by the Asphalt Paper Pipe Company of that city were recently decided valid in a suit in which the two companies forming the present consolidation were opposed. The president of the new company is John S. Cravens, of Los Angeles, president of the Southwestern National Bank. The vice-president is George H. Barker, of Pasadena, Cal., formerly president of the Edison Electric Company, of Los Angeles. The Chicago office and factory will remain under the charge of W. T. McCarthy, who has been the president and manager of the Electrolysis Proof Conduit Company at Chicago for several years. A. W. Buchanan, secretary, is the mechanical engineer and manager of the new factory at Chester, Pa. George H. Barker, vice-president, is now in the East arranging for the opening of the main Philadelphia offices in connection with the Chester (Pa.) factory, and being a man accustomed to the management of large affairs through his previous experience, will give his attention for the present to the organization of the company's business on a large scale. The general sales agent will be W. J. Barrett, who has represented Roeblings and formerly the Westinghouse Company in Los Angeles, and is one of the well-known men of the Pacific Coast. Mr. Barrett will have charge of the sales over the entire country. The company is thus making a vigorous entrance into the conduit duct manufacturing field.

The Annual New York Automobile Show.

The annual automobile show given at Madison Square Garden under the Automobile Club of America and the National Association of Automobile Manufacturers began on Saturday, January 17th, with great eclat. This is the third regular show of the kind and its success and popularity are evidenced by the crowd of exhibits as well as the number of visitors and their great desirability to inspect everything new and meritorious on view. On the opening night some seven or eight thousand persons were present, making circulation difficult, and the attendance through the present week has been of the most flattering character. The difficulty of providing for all the exhibits has been considerable in spite of the fact that not only is the large auditorium fully occupied as well as the complete upper box circle, but that exhibits have overflowed into and filled up both the ordinary restaurant and the basement. The main hall, handsomely decorated and brilliantly lighted by electricity, supplemented by numerous electrical signs, has been a dazzling spectacle, and the reports are that the visitors present representing Society have been very liberal in their purchases of the more expensive machines. At the same time much interest has been evinced in the various industrial types, and the manufacturers who have devoted their attention to these have felt very much encouraged at the outcome of their work in the patronage extended to them. We illustrate herewith the leading groups of electrical vehicles shown, there being all told some eight exhibitors of vehicles of the electrical class.

Some disappointment has been expressed in electrical circles that electrics are so few, but it should be pointed out that the makers of

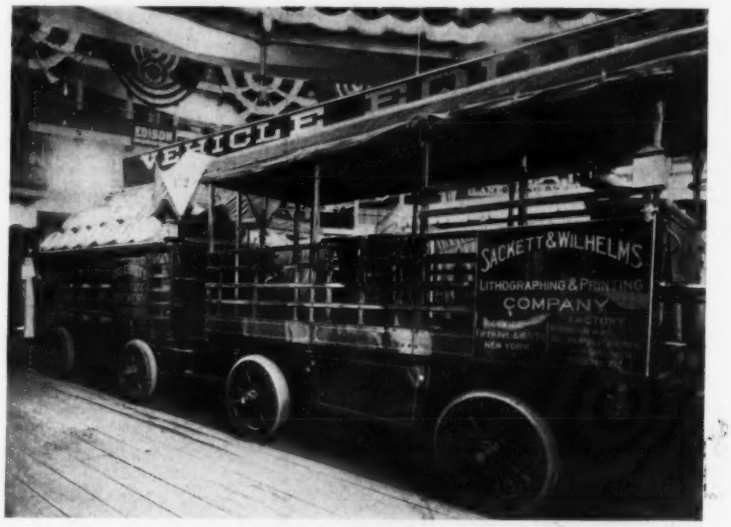


FIG. 1.—VEHICLE EQUIPMENT CO.'S EXHIBIT.

them are about as numerous as those of steam, and that the great predominance is enjoyed by gasolene, which at the present moment is undoubtedly the chief source of motive power, particularly for heavy vehicles of the touring class. In this connection, it is worthy of note that leading electrical engineers like Messrs. A. L. Riker, H. Ward Leonard and E. T. Birdsall in turning their attention to automobilism have concentrated their energies of late on gasolene types of vehicles, deliberately neglecting steam, for which they see no hopful future. It may be also noted in passing that combination vehicles wherein a gasolene engine is used to drive a generator for charging batteries and in which the generator becomes the motor to be driven by the batteries is seen to be a development of considerable interest and importance; and the work of Mr. Knight Neftel, another electrical engineer now working in this field, has been studied during the week very closely and carefully by automobilists of all kinds.

The week has been a busy one outside of the show, which constitutes one reason why automobilists from all parts of the country gather together in New York at this season. The National Association of Automobile Manufacturers has met for trade purposes and the American Automobile Association, representing the various clubs of the country, has also convened at he headquarters of the Automobile Club of America, the officers elected being as follows: President, Dr. Julian Chase, Rhode Island; first vice-president,

Honore Palmer, Chicago; second vice-president, E. E. Schryoit Reese, Cleveland; third vice-president, Charles B. Judd, Grand Rapids; treasurer, Harlan W. Whipple, Automobile Club of America; Frank G. Webb, Long Island; Dr. Milbank, Albany; William J. Stewart, New Jersey; F. C. Lewin, Philadelphia; M. C. Fleischman, Cincinnati; A. R. Pardington, Long Island. On Friday evening the National Association of Automobile Manufacturers held its annual banquet at the Waldorf, and on Saturday evening the Automobile Club of America followed at the same place with its annual banquet, attended by a large number of men of the first distinction in public life.

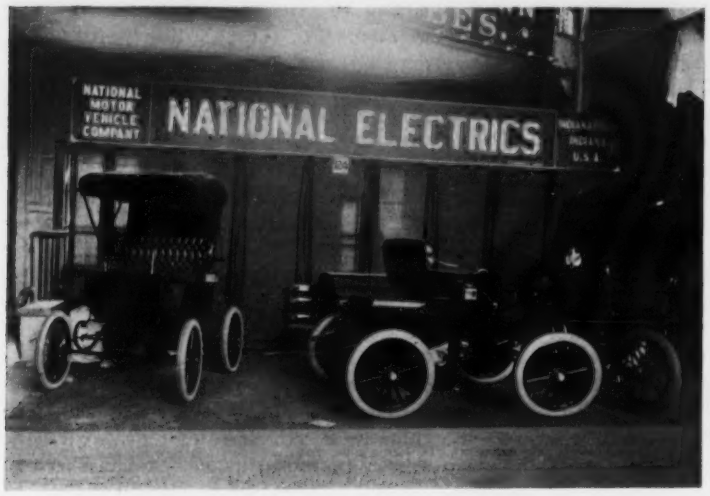


FIG. 2.—NATIONAL ELECTRIC VEHICLES.

STUDEBAKER ELECTRIC VEHICLES.—It is a matter of no small significance that a well-known carriage building concern like the Studebaker Bros., of South Bend, Ind., should concentrate their energies on the electric type of vehicle, and of these they have several examples in their large space at the show, as illustrated in one of the accompanying cuts. In these the motor used is a standard Westinghouse vehicle motor, suspended above a spring from the running gear, on which the body rests. It is so arranged as to be swung backward and forward and fastened in position, thus securing perfect chain adjustment. The transmission is by roller chain from countershaft built into the motor heads to a balance gear on the rear axle. The pull of the chain is taken by distance rods attached to the steel bars on the running gear frame and the main rear axle bearings. Twenty-four cells of standard and economical storage battery are used, so arranged as not to be directly over the motor. The controller is at the end of the seat and has four speeds, equally divided, the highest being thirteen miles per hour on good level road. The motor reverses by pressing a heel lever. There is also a cut-out emergency switch operated by the foot and fitted with removable handle so that it cannot be operated when the handle is removed. The steering is affected by a side lever knuckle jointed, and there is a band brake on the rear axle. The gears are well made and the gear frame is built of high-grade tubular steel. The indicating meter reads directly the amount of energy in the battery instead of the ordinary volts and amperes. There is a charging receptacle plug and two electric side lamps are furnished.

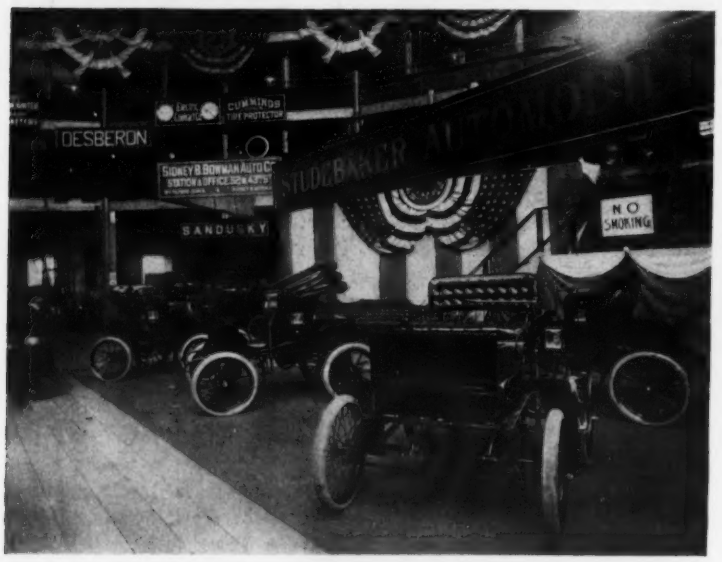


FIG. 3.—STUDEBAKER EXHIBIT.

THE ELECTRIC VEHICLE COMPANY, of Hartford, has quite a large display of its various types of automobiles, including its new hansom and new draying truck. The hansom has a more roomy top and larger windows. There is an incandescent lamp in the dome fixture. The running and operating parts are similar to those of the broughams made by this company. The motors give a speed of fourteen miles and the batteries a radius of forty miles on one charge. A special feature of the vehicle is the wheel steering arrangement, which is entirely new in hansom construction. The truck has a chassis, which will accommodate any kind of a platform or body, and is furnished in two sizes having load capacities of 10,000 pounds and 5,000 pounds, respectively, as well as a smaller size for delivery wagons and other vehicles for business and institutional uses. The running gear is of the reachless type with three-point body suspension. The truck exhibited is of two and one-half tons capacity. The two motors are each of 5 hp. A special feature is the vertical controller operated by a small wheel beneath the steering wheel. There are two foot brakes, the regular brake being of the band type acting on the outside of the drum, and the emergency brake of the internal expansion pattern. There is also an electric brake in the controller. In addition to these safety appliances, there is a heel kickout emergency switch by which the current can be cut off instantly. The underslung batteries are put in from below, being held by an ingenious automatic device which reduces the trouble of changing batteries to the minimum. The forward speeds are 2, 4, 6 and 7½ miles per hour, respectively, and there are three reverse speeds.

FIG. 4.—WAVERLEY EXHIBIT.

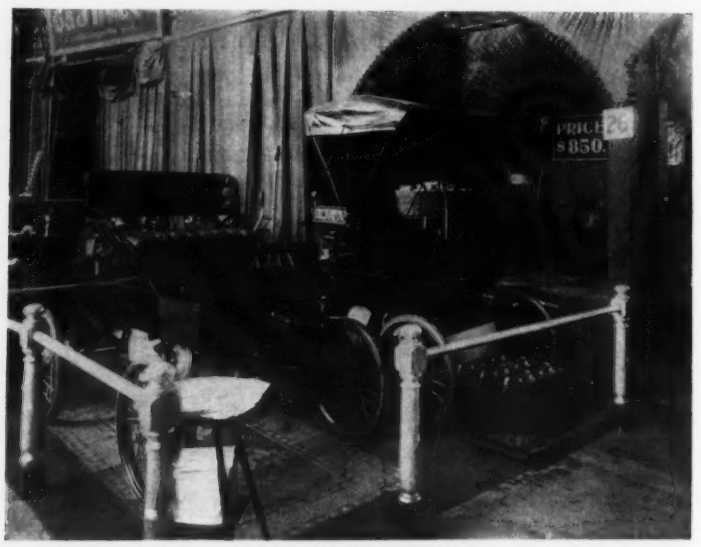


FIG. 5.—AJAX VEHICLES.

WARD LEONARD ELECTRIC COMPANY has a splendid exhibit in the gasoline high-powered automobile designed and built by its president, Mr. H. Ward Leonard.

VEHICLE EQUIPMENT COMPANY and the Rainêr Company have an excellent display of their well-known electric vehicles, particularly those of the industrial type. One example is a brewer's dray loaded with barrels. The exhibit also includes Mr. Knight Neftel's combination gasoline and electric automobile for self-charging—a very likely looking "proposition," in regard to which Mr. Neftel has to answer innumerable questions. Several have been ordered.

BAKER ELECTRIC VEHICLE COMPANY, of Cleveland, Ohio, had a very interesting exhibit of their well-known electric vehicles, in which the low-voltage type of motor and small battery equipment has been very thoroughly developed. The earlier Baker machines were

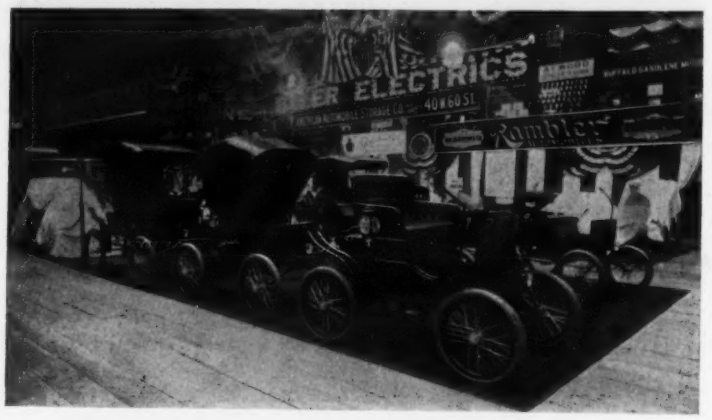


FIG. 6.—BAKER ELECTRIC VEHICLE CO.'S EXHIBIT.

of low price, and these are still made, but as shown at the Garden the concern has been tempted by orders received to launch out into the production of more luxurious carriages. These embody, however, the familiar Baker principles of design. The particular types brought to attention are the physician's chapelete, the imperial and the Stanhope.

OTHER TYPES of electric vehicles shown include those of the National and Waverley Companies, more or less familiar to our readers, and those of the Ajax Motor Vehicle Company, a new and very handy type, equipped with Gould storage batteries.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY have a neat exhibit in the restaurant of their popular automobile motor and motor vehicle charging stations, etc., already described in these columns. Messrs. Haydn Eames, of the automobile department, and W. M. Probasco, of the publication department, have been in charge.

GOULD STORAGE BATTERY COMPANY has a neat exhibit in the main hall of its various types of batteries and plates intended for automobile work and with which excellent results are steadily reported.

THE ELECTRIC STORAGE BATTERY COMPANY exhibited in the restaurant their well-known batteries and plates, laying particular emphasis on the Exide type, which of late has been so generally introduced for automobile work, and the results with which in New York hansoms, etc., of the Vehicle Transportation Company, have been very fully recorded in these pages.

THE EDISON STORAGE BATTERY COMPANY had a small exhibit at first in the east gallery boxes, but the crush around it became so insufferable it has been brought down to the main floor. There are shown details of the battery and a most interesting complete set of 38 cells fixed up as a regular automobile-operating set. There are also some interesting diagrams, curves, etc., bearing upon the subject. Messrs. Mallory, Hill and Bee have been in charge of the set, while Mr. Edison himself has been a keen observer of novelties at the show.

SIGN LIGHTING at the show is in notable profusion, and much of it has been done by the Elblight Company of America, under the personal supervision of Mr. Russell Spaulding, its president. In the space of the famous chauffeur, Mr. Henri Fournier, they have furnished a board 16 ft. long and 3 ft. high, on which appears the name Henri Fournier. Below a large photograph, 4 x 8, represents Fournier seated in his racing car. This picture is framed with Elblight cable, into which are stuck lamps representing the national colors—red, white and blue. On either side and over the top of the exhibit are hung numerous festoons of Elblight cable, into which white and green lamps are stuck alternately. Total number of lights used, 1,000. In the basement exhibit of the Central Automobile Company, the entire booth is circumscribed with festoons of Elblight cable, containing red, white and blue lamps in alternation. The cable is draped with hothouse smilax. Several large Elblight signs announce to the public the business of the firm, and a 4-ft. x 4-ft. Elblight board contains a very handsome monogram, surrounded by an Art-Nouveau design. In the exhibit of American Georges Richard Company, Barry & Hayes, agents, a large Elblight sign gives the name and address of this firm. Above it a shield representing the Arms of the French Republic, surrounded with Elblights, and Elblight board with a handsome four-leaf clover in green and white lights. The exhibits of the Baker Electric Company, United States Long-Distance Automobile Company, National Electric Company and Fire-Stone Company all have handsome Elblight signs.

C. F. SPLITDORF, 17 Vandewater Street, New York, has an excellent exhibit of spark coils.

ELECTRIC CONTRACT COMPANY, 51-53 Maiden Lane, New York, shows dry batteries and is represented by Mr. Skinner.

NATIONAL CARBON COMPANY, Cleveland, Ohio, makes an interesting and attractive display of dry batteries for automobile work.

L. H. PIGNOLET, 78 Cortlandt Street, New York, shows a line of voltmeters and ammeters of his well-known handy design.

STANDARD WELDING COMPANY displays its electric welded products.

DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, exhibits the Apple igniter in full operation, drawing a crowd all the time.

AMERICAN ROLLER BEARING COMPANY, Boston, Mass., shows its various appliances for easy traction.

JOS. DIXON CRUCIBLE COMPANY makes an excellent display of its graphite specialties, as famous in the automobile field as in any other.

VEEDER MANUFACTURING COMPANY, Hartford, Conn., exhibits odometers and tachometers.

HYATT ROLLER BEARING COMPANY, Harrison, N. J., exhibits its roller bearings for automobile use and shop equipment.

RUSHMORE DYNAMO WORKS, Jersey City.—Mr. S. W. Rushmore exhibits searchlights of the well-known Rushmore type.

Locke High-Potential Insulators.

In no way is the progress of high voltage more interestingly illustrated than in the evolution of line insulators. At first it was attempted to meet the new requirements by merely increasing the size of the ordinary insulator, but experience soon demonstrated the

FIG. 1.—80,000-VOLT INSULATOR.

futility of such a course. At present the design of high-voltage line material is an art by itself, and each new requirement brings forth designs specifically suited for all of the conditions.

Among the latest types of such insulators we illustrate two manufactured by the Locke Insulator Manufacturing Company, of Victor, N. Y., made for the 105-mile transmission line of the Mexican Guanajuato Power and Electric Company, and the line of the

Spokane (Wash.) transmission plant. In the former case the voltage is 60,000, a 19-strand copper cable equivalent to a No. 1 solid wire being employed.

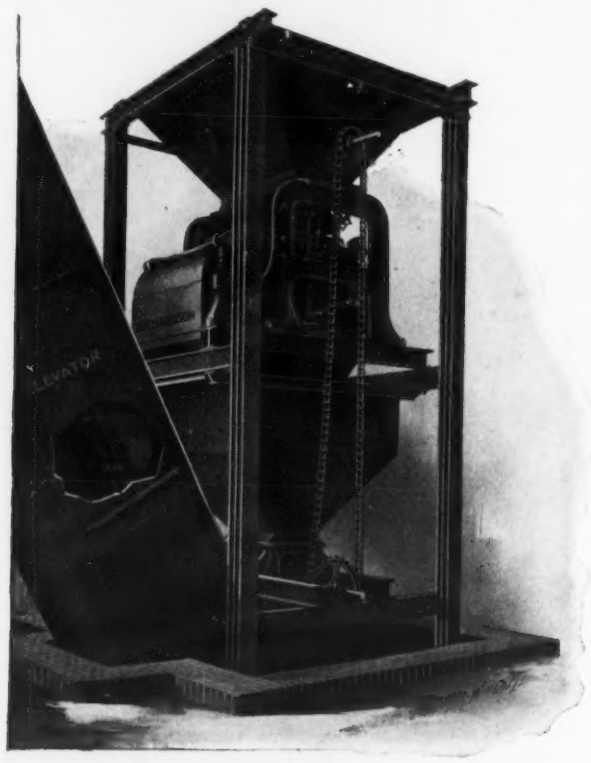
The insulator of Fig. 1 is tested for 125,000 volts and is sufficient

FIG. 2.—GLASS INSULATOR.

for a working pressure of 80,000 volts. It is 14 inches in diameter, 13 inches high and weighs 15 pounds. The insulator of Fig. 2 is a cheaper form of all-glass, but will withstand a test of 120,000 volts. Its diameter and height are 11 inches, the weight being 12 pounds.

Richardson Automatic Scales.

In the accompanying illustration is shown a view of an automatic scale in a large power station in Bristol, England, where it is used



AUTOMATIC SCALES.

to check the coal as it enters the plant. These scales are also used to weigh and register the coal as it goes into automatic stokers.

The material to be weighed is supplied from a hopper or bin above the scale, and is admitted into the weigh-hopper by means of a swinging cut-off, which, at the beginning of the operation, is open. When the charge is nearly completed, the cut-off, actuated by the increased weight of the weigh-hopper, partially closes and reduces the stream of material. When an exact balance is reached the cut-off completely closes, stopping the flow, and in doing so throws up a lever which sets in motion the mechanism which opens the bottom of the hopper. As soon as the charge has been dumped, the hopper is again closed and locked. In the operation of closing the bottom of the hopper the dumping mechanism strikes the lever, throwing it down, and thereby causing the cut-off to open and allow a new charge to flow into the weigh-hopper. The movement is a very simple one, the only power required being the momentum of the falling material.

It is claimed that there is an accurate balance of every weighing. The drip or column of material which is in the air at the moment the feed is automatically cut off is compensated for by a novel contrivance which works automatically, and without the manipulation of any of the working parts. The hopper delivers its discharge without any rocking or vibration on the delicate knife edges.

These scales, which are manufactured by the Richardson Scale Company, 19 Park Row, New York, are adapted to the weighing of many different materials and are made in various sizes, with hopper capacities running from a few ounces to six tons.

Incandescent and Arc Lamp Fittings.

A type of incandescent lamp cord adjuster is shown in Fig. 1, which is at once both simple and neat, and takes care of the surplus cord in a satisfactory manner. The illustration shows very clearly the method employed in using these spools. The spools are in two sizes, one

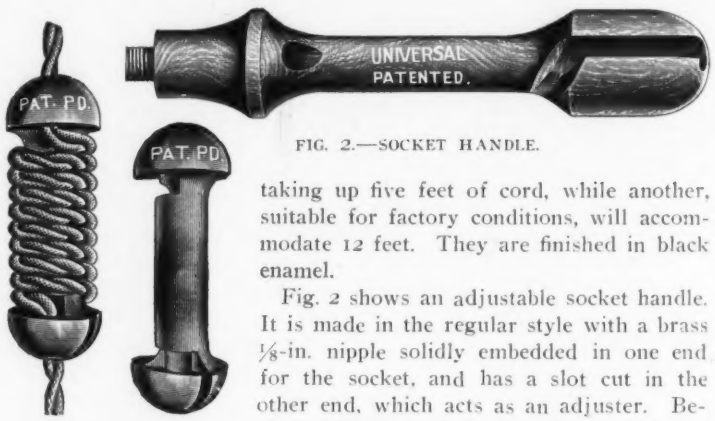


FIG. 1.—CORD ADJUSTER. FIG. 2.—SOCKET HANDLE.

taking up five feet of cord, while another, suitable for factory conditions, will accommodate 12 feet. They are finished in black enamel.

Fig. 2 shows an adjustable socket handle. It is made in the regular style with a brass ⅛-in. nipple solidly embedded in one end for the socket, and has a slot cut in the other end, which acts as an adjuster. Between the two ends the handle is so shaped as to fit well in the hand, and will take up 15 feet of cord. The cord is wound around the handle to the desired length and slipped into the slotted end, where it is firmly held.

In Fig. 3 is shown a simple form of arc lamp hanger, known as the McDonald hanger-board. It is made of porcelain, 7 x 4 inches,

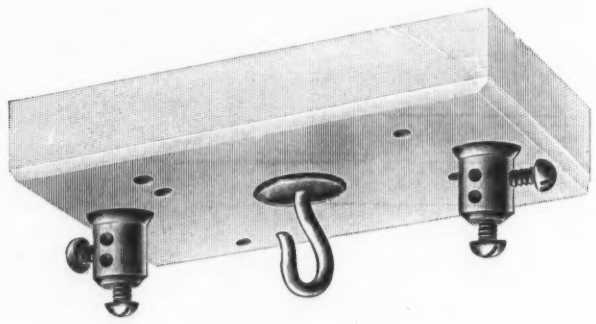


FIG. 3.—ARC LAMP HANGER.

and is provided with terminal binding posts for the leads and an insulated hook for suspension.

All of these specialties are manufactured by the Crescent Electric Company, Chicago, Ill.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 5 a 5½ per cent. for all dates, it being more freely offered during the week. There was less activity in stocks, the market being dull at moderate concessions, with little public support. The declines were general and regular; Manhattan, however, was strong on investment buying. This stock advanced from 152¼ to 154¼, the lease of the road to the Interborough Company, it may be noted, having been ratified on Friday. The industrials, on the whole, were dull, but the United States Steel stocks, though losing ground to a slight extent, showed considerable firmness. Amalgamated Copper was heavy on the copper trade situation, declining from 65⅜ to 62¼. Among the tractions Brooklyn Rapid Transit closed at 68¼ (⅛ point above the lowest figure of the week), being a net loss of 1 point, on sales of 41,290 shares. Metropolitan Street Railway closed at 141½ on light trading, practically holding its own since our last report. Manhattan closed with a net gain of ⅞, the last quotation of the week being 153⅞. The electric list shared the weakness of the general market, General Electric losing ¾ point net, closing at 186½. The range of prices of this stock was 187, the highest, and 186, the lowest. Westinghouse common and preferred closed at 217 and 220, being net losses of 1 and 4 points respectively. Western Union's closing price was 91½, ½ point below our last previous quotation. American Telephone & Telegraph made a net gain of 5¼ points, closing at 165½, the highest figure of the week. In Boston this stock advanced ½ point, on a fairly active market. Following are the closing quotations at New York on January 20:

NEW YORK.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Tel. & Cable	85	85	General Electric	185	185
American Tel. & Tel.	164	160	Hudson River Tel.	...	...
American Dist. Tel.	39	38	Metropolitan St. Ry.	141⅛	140⅛
Brooklyn Rapid Transit	68⅝	67¾	N. E. Elec. Veh. Trns.	...	...
Commercial Cable	...	...	N. Y. & N. J. Tel.	161	161⅛
Electric Boat	22	22	N. Y. E. V. T. Co.	11	10½
Electric Boat pfd.	37	37	Tel. & Tel. Co. Am	...	...
Electric Lead Reduction	3⅝	3	Western Union Tel.	91¾	90¼
Electric Vehicle	6¾	8⅛	Westinghouse com.	212	210
Electric Vehicle pfd.	.	13⅛	Westinghouse pfd.	212	210

BOSTON.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Tel. & Tel.	164½	163¼	Western Tel. & Tel. pfd.	101	101
Cumberland Telephone	..	..	Mexican Telephone	2⅛	2⅛
Edison Elec. Illum.	.	..	New England Telephone	138	137
General Electric	..	..	Westinghouse	104	103
Western Tel. & Tel.	..	26½	Westinghouse pfd.	109	103

PHILADELPHIA

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
American Railways	..	..	Phila. Traction	98⅛	98¼
Elec. Storage Battery	79	86*	Phila. Electric	8⅛	8⅜
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9¾	9⅛	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Jan. 13.	Jan. 20		Jan. 13.	Jan. 20
Central Union Tel.	..	..	National Carbon pfd.	97	98
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry.	215	230	Union Traction	16⅛	16⅛
Chicago Tel. Co	..	..	Union Traction pfd.	50	50
National Carbon	26	25			

*Asked.

INCREASE OF STANLEY ELECTRIC STOCK.—The directors of the Stanley Electric Manufacturing Company, at a meeting held on January 10, passed a resolution, providing that the capital stock of the company be increased from $3,000,000 to $10,000,000, and the stockholders will meet on February 11 to approve this action of the board. Plans for this great increase of facilities have been under way for some time, to the end of placing the company on a basis to compete favorably with the largest electrical manufacturers in the country. It will be remembered that the Stanley Company recently secured an order from the New York Edison Company aggregating over a half million dollars for dynamos and other electrical apparatus, some of which is to be the largest of its kind ever constructed. This indication of its invading the field of heavy work is now amply verified. Moreover, funds will be provided by this increase of capital for certain important developments which the engineers of the company have been planning for some time. Among these developments is a new system of operation for heavy long-distance electric railways employing electric locomotives, which will use the current directly without rotaries or transformers. The potential and phase to be employed has not yet been announced, but it is stated that the power stations will not have to be located nearer than 50 to 75 miles apart. The system is not that of the Ganz Company, but is due to the work done by the engineers of the Stanley Company on patents on which rights have been secured from engineers in this country and abroad. These patents involve the use of a new form of generator with a new type of motor, which permits the use of high voltages directly on the car and absorbs practically no energy in resistances on starting.

CHICAGO TELEPHONE.—The Chicago Telephone Company has just closed a surprising year's business in matter of gross increase. During December the company installed 1,500 Bell telephones for new subscribers and brought its total number of instruments now in use in the city to upward of 60,000. The gain made during the last two years, or since Mr. Sabin took hold of the company, is nearly 33,000 telephones. The company has made the largest increase in the nickel-in-the-slot machines, which are now located on a remunerative basis in many public places and private dwellings that would have formerly hesitated at paying full rates charged for the service. Attorneys for the company say they have no intimation of when the Appellate Court will render a decision in the maximum telephone rate case. While they are hopeful of winning the suit, they declare that if the ruling is against them an appeal will be taken to the State Supreme Court.

J. G. WHITE & CO.—This English concern reported a very satisfactory year at its third annual meeting. The profit and loss account showed, after including the sum of £3,649 16s 11d brought from last year, a total of £29,480 13s 3d to be dealt with, and this was allocated in payment of dividends, free of tax, at the rate of 8 per cent. per annum on the preference and ordinary shares to August 31, 1902, which will absorb the sum of £7,948 14s 9d, to place to the reserve fund the sum of £10,000, and to carry forward to the next year's account the sum of £11,469 18s 6d. English papers just to hand record the successful opening at Bournemouth of the conduit tramway system installed there for the corporation, with a side slot system, carried out under the direction of Mr. A. N. Connett, chief engineer of the company.

SUSQUEHANNA WATER POWER.—At Baltimore, Md., on January 15, upon the payment of $904,237 the United Railways handed over to the Continental Trust Company the entire common stock of the United Electric Light & Power Company, amounting in par value to $2,000,000. President Warfield of the trust company said the syndicate his company was representing was not ready to announce its plans. This deal is the initial step in the $10,000,000 project to develop electrically the water power of the Susquehanna River and transmit it to Baltimore, Wilmington, Del., and Philadelphia. The Continental Trust Company closed a contract several months ago for its clients to supply the United Railways with power for thirty years, reaching a maximum of 40,000 hp.

NEW STOCK FOR MANHATTAN.—A circular has been issued to Manhattan Elevated stockholders announcing that the company has duly voted to increase the capital stock from $48,000,000, consisting of 480,000 shares of the par value of $100 each, to $60,000,000, consisting of 600,000 shares of the par value of $100 each, and the issue of 72,000 shares of the new stock at the present time has been duly authorized. The opportunity is now offered to the stockholders of the company, of record at the closing of the transfer books on Tuesday, January 27, 1903, to subscribe for $7,200,000 of said increased capital stock at par, to an amount equal to 15 per cent. of their respective holdings. The new stock will be entitled to all dividends declared after its issue.

TELEPHONE STOCK LISTED.—An additional $21,937,000 of the capital stock of the American Telephone & Telegraph Company has been listed on the New York Stock Exchange, making total amount listed $104,740,400. In its application the company stated that it now holds over $120,000,000 of stocks and bonds of telephone companies, eight million and seventy-three thousand of the $9,980,000 stock of the Bell Company, of Philadelphia; $6,240,000 of the $11,993,000 of the Chicago Telephone Company; $19,329,000 of the $30,000,000 of the New York Telephone Company, and $21,440,000 of the $32,000,000 of the Western Telephone & Telegraph Company. It also owns $6,008,000 of the $10,000,000 capital stock of the Western Electric Company.

MACON (GA.) RAILWAY & LIGHT.—There has been filed in the office of the Secretary of State of Georgia a certified statement of the recent bond issue of the Macon Railway & Light Company, which aggregated $1,000,000. The bonds were issued as a deed of trust to the New York Investment & Trust Company.

THE EMPIRE CITY SUBWAY COMPANY (LTD.), of New York City, has increased its capital stock from $2,250,000 to $2,750,000 for the purpose of carrying on new construction work during the year.

CANADIAN MARCONI WIRELESS TELEGRAPHY.—The plans of the Canadian Marconi Company, recently organized, contemplate a vigorous campaign for the installation of the system throughout the Dominion. Mercantile and shipping interests on the Pacific coast are now negotiating with the company for the inauguration of the system upon trans-Pacific steamships and on steamers plying in the Alaskan trade. The dangerous coast of British Columbia and Alaska require some means to prevent accidents and to enable shipping interests to keep in touch with vessels plying in the coastwise trade. In order to secure the immediate application of the Marconi system, these interests have agreed to subscribe to a sufficient amount of stock or bonds to pay for the installation of the land stations. Vessels will also be equipped with instruments by the interests named, and the general adoption of the Marconi wireless system on the Pacific coast is said to be assured. The connection of the Canadian Yukon territory with British Columbia will be among the first important measures of the company. The officers are: Directors—Col. F. C. Henshaw, president; Guglielmo Marconi, vice-president; Andrew A. Allan, of the Allan Line steamships; Rodolphe Forget, Beaumont Shepard, secretary; Willard Reed Green, New York; John D. Oppe, representing Marconi's Wireless Telegraph Company, Limited, of England (the parent company) and managing director of the Canadian company. Representatives of important holdings of shares in Toronto and the far west will be added to the board, it being the intention to have all the important and widely scattered interests concerned represented on the board. The capital (1,000,000 shares) has all been subscribed. The par value of the shares is $5 each in order to correspond nearly with the £1 shares of the English parent company, which £1 shares have been for some time past selling at over £3. The English company has received $3,000,000 in stock for its property rights and patents.

NEW COMMERCIAL CABLE STOCK.—The capital stock of the Commercial Cable Company will be increased to the full amount authorized, $15,000,000, with rights to shareholders to subscribe to 12½ per cent. of their holdings. The amount of capital outstanding now is $13,333,000. It is understood that the stock will be offered to shareholders at par, which will make the rights valuable, as the price of the shares is now ranging near 175. The company pays 7 per cent. regular dividends, and 1 per cent. extra yearly. Last year less than 2,500 shares of the stock were traded in on the local exchange, in the month of December only twenty shares changing hands, at 160, on December 30. The next day 175 was the asked price and 168 bid. Since then a few hundred shares have been traded in here and in Montreal, near 171, and this week a sale was made in Montreal at 174, with bids at 174 and the asked price at 180, at one time. The new capital will be used, it was believed, to pay for the new Pacific cables of the company. The Mackay-Bennett interests in this company are generally recognized as having been kept intact since the death of John W. Mackay.

BOSTON & WORCESTER.—The trustees of the Boston & Worcester Electric Companies held a meeting last week for organization and elected James F. Shaw president and George A. Butman secretary and treasurer. The Boston & Worcester Electric Companies is a voluntary organization formed after the manner of the Massachusetts Electric Companies and the Boston Suburban Companies, with 38,775 shares of stock outstanding, par $100, of which 18,786 shares are a 4 per cent. preferred stock issue and 19,989 shares are common stock. The company owns the Boston & Worcester Street Railway Company, Framingham Union Street Railway Company and Framingham, Southboro & Middleboro Street Railway Company. The companies have been financed. It is now completing the construction of its system between Boston and Worcester, and by April 15 it is expected it will have cars running between Boston and Framingham and to have cars running through to Worcester by July 1. The securities will be listed upon the Boston stock exchange.

PUGET SOUND TRACTION.—The Puget Sound Electric Railway Company has filed in the Hudson County Clerk's office at Jersey City an amended certificate of incorporation, fixing the capital stock at $4,500,000, of which $1,000,000 consists of 6 per cent. non-cumulative preferred shares. The company operates electric railways and light and power plants in the vicinity of Puget Sound. The incorporators are Preston Player, Nathan H. Daniels, Jr., Howard L. Rogers, Henry Reed Hayes, George C. England, Waldo E. Forbes, Alvah K. Todd, Gardner Rogers, and Louis B. Dailey.

DIVIDENDS.—The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable February 15. Th..e Hudson River telephone directors declared the regular quarterly dividend of 1½ per cent., payable February 2. The Allis-Chalmers Company, at its directors' meeting, held January 15, declared the regular quarterly dividend on the preferred stock. The directors of Chicago Edison have declared the regular quarterly dividend of 2 per cent., payable February 2.

Commercial Intelligence.

THE WEEK IN TRADE.—Most satisfactory reports as to trade conditions continue to come in, and the "wave of prosperity" shows no other signs than those of increase and plenty. In commenting on the situation, *Bradstreet's* says: "With the much-needed expansion in export trade now actively in evidence, one of the few important missing elements of national prosperity has been supplied." Export trade in December proved to be better than anticipated, and so far in January only encouraging elements have developed. The domestic situation also gains rather than loses in strength. Spring trade, although hardly opened, is active and steadily increasing, and confidence in a heavy business is expressed. Money is easier; failures are better than usual at this season of the year and railway earnings continue equal to the best for this season. All of the industries are exceptionally active, the possible exception to this being where there are shortages of fuel. The iron and steel trade still holds its strength. The 1902 pig iron production is stated to be not far from 17,750,000 tons, and it is estimated that the current output is the largest in the country's history. The steel rail mills of the country, it is stated, will not accept any more orders at the present time. Structural material, bars and plates are in active demand. Copper has held nearly all of the recent advance despite bearish statistical features. The last quotations were 12.25c. for Lake; 12.12½c. for electrolytic, 12c. for casting stock, and 11.50c. for Standard. According to *Bradstreet's,* the number of business failures during the week ending January 15 numbered 234, as against 336 the week previous and 291 in the corresponding week last year.

BIG EQUIPMENT FOR CANADA.—Several important contracts are about to be let in the United States for the equipment of large locomotive works which are to be built in Montreal. All the machine tools will be electrically operated. Electric traveling cranes will also be installed in the plant, which is to be erected on some 80 acres of land adjoining the St. Lawrence River. The initial equipment to be purchased in the United States will represent an expenditure of more than $300,000. Eventually the concern—the Locomotive & Machine Company, of Montreal—whose offices are in the Street Railway Chambers, Montreal, which will operate the works, propose to construct a ship and bridge building plant. The initial works will consist of machine shop, erecting shop, boiler shop and foundry, to be equipped with the most modern appliances and labor-saving devices. The yearly output will be 200 locomotives. It is intended to reach out for foreign trade. Canadian capital will be employed exclusively in the enterprise. M. H. Haney, of Toronto, who built the major portion of the Canadian Pacific Railroad in the Northwest, and M. Davis, of Montreal, who is also a railroad contractor, are primarily interested in the project. M. Brophy, another Canadian railroad contractor, is to be the general manager of the company. An American will be the superintendent of the new plant, the services of D. R. Shea, formerly of the Schenectady Locomotive Works, Schenectady, N. Y., having been secured. The locomotive plant is expected to be completed by August.

HYDRAULIC PLANT FOR SYDNEY TRAMWAYS.—Private advices from Australia state that the New South Wales Government Railroad and Tramway Commissioners are considering the advisability of developing the additional power required to operate the balance of the Sydney City & Suburban Tramway system, now under construction, by means of water power. The press reports that O. W. Brain, the electrical engineer of the New South Wales government, during his recent visit to the United States, had placed a contract with the Westinghouse interests for the additional power house equipment required, were entirely premature. Mr. Brain was not empowered to arrive at any decision in the matter, as he was only instructed to gather data for submission to the commissioners. In this connection it may be said that in the majority of instances foreign engineers, particularly if they represent government or municipal interests, who visit this side, are not in a position to close contracts, but are sent here to secure estimates and inspect plants, etc.

ALBERGER COOLING TOWER CONTRACTS.—The Alberger Condenser Company, White Building, Liberty Street, has lately taken a contract for a large cooling tower for the Nassau Light & Power Company, of Rosslyn, L. I. Contracts have also been secured for towers for the Pittsburg Reduction Company, at East St. Louis, Ill., and for the Laurel Lake Mills, Fall River, Mass. The latter contract calls for the erection of an especially large tower 20 feet in diameter and 80 feet high. Two large Alberger fan-draft cooling towers have been ordered by the Pacific Light & Power Company, of Los Angeles, Cal.

COPPER FOR GENERAL ELECTRIC.—It is stated that the General Electric Company has just purchased a six-months' supply of copper at the full market rates, about 13,000,000 pounds.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended January 17: Antwerp—8 pkgs. machinery, $6; 95 pkgs. material, $4,544. Argentine Republic—29 pkgs. material, $2,121; 4 pkgs. machinery, $219. Berlin—1 pkg. material, $62. Brussels—3 pkgs. material, $135. British Possessions in Africa—54 pkgs. machinery, $4,784; 6 pkgs. material, $320. Brazil—150 pkgs. material, $6,952; 6 pkgs. machinery, $993. British Australia—18 pkgs. machinery, $970; 33 pkgs. material, $786. British East Indies—14 pkgs. machinery, $949; 11 pkgs. material, $765. British West Indies—18 pkgs. material, $388; 69 pkgs. railway parts, $1,845. Cuba—77 pkgs. material, $1,775. Chili—382 pkgs. material, $3,239. Central America—9 pkgs. material, $235; 22 pkgs. machinery, $4,800. China—7 pkgs. material, $83. Dutch West Indies—2 pkgs. material, $16. Frankfort—6 pkgs. machinery, $1,500. Glasgow—5 pkgs. machinery, $725. Genoa—9 pkgs. material, $430. Hong Kong—46 pkgs. material, $1,770; 58 pkgs. machinery, $2,690. Hayti—1 pkg. material, $21. Hamburg—14 pkgs. machinery, $942; 67 pkgs. material, $1,631. Havre—12 pkgs. material, $520; 17 pkgs. machinery, $1,415. Japan—185 pkgs. machinery, $56,433; 2 pkgs. material, $117. Leeds—1 pkg. machinery, $115. Liverpool—219 pkgs. machinery, $19,812; 56 pkgs. material, $3,831. London—280 pkgs. machinery, $18,664; 382 pkgs. material, $15,932. Manchester—1 pkg. machinery, $50. Mexico—19 pkgs. material, $489; 1 pkg. machinery, $225. Milan—1 pkg. machinery, $9. New Zealand—1 pkg. machinery, $60; 196 pkgs. material, $6,218. New Castle—7 pkgs. machinery, $600. Peru—31 pkgs. material, $1,480. Philippine Islands—946 pkgs. material, $8,415. Siam—1 pkg. machinery, $350. Southampton—30 pkgs. material, $806. Venezuela—2,072 pkgs. material, $8,809. Warsaw—2 pkgs. machinery, $50.

THE INTERNATIONAL SMOKELESS POWDER AND DYNAMITE COMPANY recently made some additions to its plant, and has purchased from the Westinghouse Electric & Manufacturing Company a 180-kw, 2-phase alternator with switchboard and a number of induction motors ranging in size from 7½ hp to 50 hp. The motors will be used to drive apparatus used in the making of smokeless powder, for which purpose the induction motor is especially well suited on account of the absence of commutator, slip rings, or other moving contacts. The first Westinghouse apparatus was sold to this company two or three years ago and consisted of a 60-kw alternator with several motors. Additions were made from time to time in the different buildings and it was soon found that a larger generator would have to be installed. A 120-kw generator was then bought, which has operated successfully up to the present time, when it is found that both machines are very heavily overloaded. The powder company has, therefore, put in the 180-kw alternator mentioned above. The company states that the entire equipment has given perfect satisfaction and that there has not been a time when the machinery has been shut down for a minute.

DECORATIVE LIGHTING CONTRACTS.—Among recent decorations installed with the Norbitt temporary decorative socket, was that of E. S. Brown Company, of Fall River, Mass., the largest department store in New England. The decoration consisted of 2,700 4-cp lamps, and about 1,000 8-cp lamps. The entire equipment was installed in less than forty-eight hours, and most of it by unskilled labor, as the firm did the entire equipment themselves, under the supervision of one of the members of the firm. This shows the simplicity of the device for unskilled labor especially. Another large installation was that installed by a large Baltimore contractor, for the wedding of the daughter of Dr. Emerson, of Bromo-Seltzer fame. This decoration consisted of about 1,500 Norbitt temporary decorative sockets. Among other installations were that of the Delaware Club, December 9th, at Terrace Garden, New York, 2,100 lights, and the Bachelor Circle of the German Liederkranz Society, at their club house in Fifty-eighth Street, January 8th. The demand for these sockets has been so great that the company are working night and day filling orders.

WESTINGHOUSE IN ENGLAND.—A cable dispatch from London of January 9 says: "The Westinghouse Electric Company is making an effort to increase the interest of English railroads in electric traction. The company expects to secure large contracts, especially from the Great Northern and Great Eastern and the two southern lines. For some time the Great Northern has been conducting experiments at the Westinghouse works at Manchester and the Great Eastern has been testing the electric system in a similar manner near London. The chairman and managers of the principal English railways dined in London to-night as the guests of George Westinghouse. The occasion was taken advantage of to exhibit the new Hewitt mercury vapor light and to introduce the general question of electrical developments for railroads. Lords Kelvin, Rayleigh, Allerton and Claude Hamilton and many leading railroad men and scientists inspected the Hewitt light this evening at the Westinghouse offices." The new Hewitt static converter, fully described in these pages last week, was also shown.

FOREIGN TRADE FOR 1902.—Merchandise exports in December, 1902, ran up to the fine figure of $148,000,000, a sum but once exceeded. Total exports for 1902 footed up $1,360,696,355, averaging $108,891,363 a month, a figure which December exports exceeded by $39,115,460. The year's export total is below the figures made in 1901 and 1900, owing to the short crops, showing a decrease from 1901 of $94,679,505, or 6.5 per cent., and from 1900 of $117,249,758, or 7.9 per cent. It exceeds 1899 and 1898, however, by 6.7 per cent. and 8.4 per cent. respectively. The balance of trade in favor of the United States has since 1900 been almost cut in two. For 1902 the excess of exports is $391,426,346, a drop from 1901 of 33.1 per cent., and from 1900 of 39.6 per cent. A comparison of totals for six years past is as follows:

Year.	Exports.	Imports.	Excess exp.
1902	$1,360,696,355	$969,270,009	$391,426,346
1901	1,465,375,860	880,419,910	584,955,950
1900	1,477,946,113	829,149,714	648,796,399
1899	1,275,467,971	798,967,410	476,500,561
1898	1,255,546,266	634,964,448	620,581,818
1897	1,099,709,045	742,595,229	357,113,816

The excess of exports for December of $53,699,619 compares with $57,012,000 a year before and $77,192,000 two years before. During 1902 the balance of trade swung from $50,006,988 in January as low as $9,643,753 in July, then recovering to $55,692,290 in October, a figure not since touched.

EQUIPMENT FOR NEW INGERSOLL-SERGEANT PLANT.—The Ingersoll-Sergeant Drill Company, 26 Cortlandt Street, New York, has just placed some important contracts for equipment to be installed in its new plant at Phillipsburg, N. J., to be electrically operated. The contract for the boilers—1,500 hp—has been let to the Sterling Company, of Chicago. The engines, representing in all a capacity of 1,000 hp, will be built by the C. & G. Cooper Company, Havemeyer Building. The generators will be manufactured by the Crocker-Wheeler Company. The machine tools will be electrically operated in groups. The motors supplied will be Crocker-Wheeler motors.

EQUIPMENT FOR A SULTAN'S PALACE.—The Sultan of Linga's palace at Rheo, Malay Peninsula, is to be equipped with an up-to-date Yankee plant, which will be used for lighting and for operating fans, also of American manufacture. The order was taken by the Singapore office of Bagnall & Hilles. The dynamo—a 75-kw machine—will be furnished by the Sprague Electric Company. The engine is to be built by the Ames Iron Works, Oswego, N. Y. The fans will be of Lundell type. Electricity is also to be employed for the purpose of operating an ice-making and refrigerating plant.

WIRELESS TELEGRAPH PURCHASE FOR NAVY.—The officials of the De Forest Wireless Telegraph Company learn that their plant, which has been operated under the supervision of a naval board between Washington and Annapolis, proved so successful at official tests made that a complete set of apparatus has been purchased for use in the navy. The army, according to Mr. Firth, a director of the company, has already supplanted its cables between Sandy Hook and Fort Wadsworth with De Forest apparatus, which has been in active operation for about three weeks.

ELECTRICAL EQUIPMENT FOR SOUTH AFRICAN OFFICES.—The Mutual Life Assurance Company of New York, 32 Nassau Street, is to erect a $700,000 office building in Cape Town, South Africa, which will be equipped with electrical machinery, etc. The building, designed by Roos & Booraem, will be electrically lighted by a 140-hp plant, the contracts for the supply of which will be let by the Wells & Newton Company, engineers, Seventeenth Street and Avenue B, New York. The elevators will be built by the Otis Elevator Company.

ALLIS-CHALMERS SALES.—Among the numerous sales of large engines by the Allis-Chalmers Company in December we note the following: Hocking Valley Railway Company, Columbus, Ohio, 18 x 36 1890 frame Reynolds Corliss engine; George A. Fuller Company (for Bellevue-Sttratford Hotel), Philadelphia, Pa., three 22 x 42 1890 frame Reynolds-Corliss engines; Transit Development Company, Brooklyn, N. Y., two 42 x 86 x 60 vertical cross compound Corliss engine, direct-connected.

BALL ENGINE ORDERS.—The Cleveland Worsted Company, Cleveland, Ohio, is installing a 175-hp tandem compound engine, direct-connected to a Westinghouse alternator. The Ball Engine Company, Erie, Pa., furnished the engine. The Pittsburg Spring & Steel Company, Pittsburg, Pa., is installing an electric light and power plant, consisting of two 160-hp engines direct-connected to Westinghouse generators. The Ball Engine Company built the engines for this installation.

FIRST LIGHTING CONDUIT FOR FAR EAST.—The introduction of interior conduit in connection with electric lighting in the Far East is about to take place. The material, which will be furnished by the Sprague Electric Company through Bagnall & Hilles, Yokohama, is intended to be installed in the new building of the Yokohama Specie Bank.

General News.

THE TELEPHONE.

HELENA, ARK.—The Southwestern Telephone Company will, it is said, install a new system in Helena on account of deficiencies in the present system. A new switchboard and 450 new telephones will be included among the improvements.

PASADENA, CALIF.—Upon petition of the Home Telephone Company, the City Council has unanimously voted to advertise for sale a telephone franchise of thirty-five years' duration.

MACON, GA.—Work has been started on the Macon end of the new telephone line being constructed by the Southern Bell Telephone Company, from Macon to Savannah, by way of Millon.

GIBSON CITY, ILL.—The Dix Telephone Company has accepted the franchise granted by the City Council.

PONTIAC, ILL.—Ray Blasdel, representing local capitalists, has asked the city for a franchise to construct and operate a telephone line within the city.

ROCKFORD, ILL.—The directors of the Home Telephone Company decided to extend the Rockford line to Freeport, Beloit and Belvidere and to connect with the Inter-State Independent Telephone Company's lines.

CHICAGO, ILL.—Fifty-seven persons and business firms were granted leave by Judge Tuley a few days ago to become co-complainants in the injunction suit brought by the Illinois Manufacturers' Association against the Chicago Telephone Company to restrain the latter from charging more than the franchise rate of $125 a year for its service.

HARDIN, ILL.—The directors of the Calhoun Telephone Company have elected new directors, as follows: S. A. White, C. H. Lamar, L. A. DeLong, McC. Johnson and S. J. Merida. A 9 per cent. dividend was declared. The company is making efforts to complete a new line from Batchtown to Grafton. When completed a metallic circuit will be established to St. Louis via Grafton.

ELKHART, IND.—The Home Telephone Company has increased its capital stock from $100,000 to $160,000 to provide for improvements.

LAGRANGE, IND.—The Newbury Township Telephone Company has elected the following-named officers: President, J. C. Prough; vice-president, Frank Lupold; secretary, Geo. L. Mishler; treasurer, A. H. Miller.

MADISON, IND.—Application has been made for the granting of a franchise for a telephone toll line through the city of Madison and Jefferson County. It is intended to establish an exchange at Hanover.

EVANSVILLE, IND.—Sherman Davis used profane language over a telephone line in this city and he was arrested and fined by Judge Curry, who held that the statute prohibiting profane language in public places had been violated.

WINAMAC, IND.—The Winamac, Kewana and Knox Telephone plants have been sold to the Winchester syndicate, headed by J. L. Thompson, which will buy a good many of the Northern Indiana exchanges. All these properties will be improved and extended.

KOKOMO, IND.—The Citizens' Telephone Company, of Kokomo, on Jan. 9, certified to the Secretary of State that its capital stock had been increased from $25,000 to $100,000 for purposes of repairing and extending its lines. The increase was accomplished by issuing 1,500 additional shares of the stock of the company at the par value of $50 each. Stephen Tuder is president and Charles A. Jay, secretary.

INDIANAPOLIS, IND.—The Peoples' Co-operative Telephone Company, of Clarkshill, has incorporated with a capital stock of $500. There are 200 original shares of stock and were taken at $2.50 per share. The company proposes to establish, maintain and operate telephone lines in Tippecanoe, Clinton and Montgomery Counties, with an exchange at Clarkshill. Mr. N. J. Baily, president, says the capital stock will be increased.

MENTONE, IND.—The People's Mutual Telephone Company, of Silver Lake, has had a complete change in its management owing to the dissatisfaction of stockholders with the old management. At the annual meeting Carlin Myers, of Mentone, was elected president to take the place of Henry L. Oldfather. The old management refused to turn over the books to the new officers, and the difficulties may be carried to the court for settlement.

GAS CITY, IND.—It is charged that the Central Union Telephone Company is conducting a war on the sly against the United Company, a new concern. The United Company put exchanges in at Gas City and Joneston and many people have deserted the Central Union, although both companies are supposed to make the same rates. It is charged that the Central Union is giving free use of telephones to many people, but officers of the company deny it.

COTTONWOOD, IA.—The German-American Telephone Company is building a branch line to Houghton.

HAMBURG, IA.—The farmers east of town are putting up a telephone line to connect with Page County and Hamburg.

DES MOINES, IA.—The Farmers' Mutual Telephone Company will establish an exchange at Yarmouth to cost $7,000.

FOREST CITY, IA.—The Great Northern Telephone Company, of Forest City, has increased its capital from $25,000 to $75,000.

SALIX, IA.—At a special election a franchise was granted to J. H. Quick, of Sioux City, and R. H. Countermine, of this place, to operate a telephone exchange here.

FT. DODGE, IA.—The capital stock of the Fort Dodge Telephone Company has been increased from $50,000 to $100,000. Extensive improvements will be made to the company's plant in this place.

DETROIT, MICH.—Mayor Mayberry has vetoed the telephone merger franchise and there is little chance of its passing.

JACKSON, MICH.—The Peoples' Telephone Company has increased its capital stock from $200,000 to $250,000. The company has recently commenced operations with 1,200 subscribers.

JOPLIN, MO.—The telephone girls' strike, which resulted in 25 girls walking out of the office two weeks ago, resulted in a limited boycott last week. Committees of girls are imploring the subscribers to discontinue the service, and it is claimed that 500 telephones have been taken out.

FREEHOLD, N. J.—The Monmouth Toll Line Company, which was incorporated last fall, has issued a prospectus. The company intends at once to build lines to connect with the present independent Freehold telephone system, also with the Farmers' & Traders' Telephone Company, at Hightstown. From the last-named place it is proposed to connect direct with Trenton, or the State Telephone Company's lines, thus securing connection with Bound Brook, Newark, Jersey City, Trenton, Philadelphia and many small towns. The company also proposes to build connecting lines in various other directions. Mr. C. N. Fuller, of Freehold, N. J., is at the head of the enterprise.

NEW YORK, N. Y.—The Porto Rico Telephone Company has increased its capital stock from $100,000 to $400,000.

NEWTON, N. C.—The Newton Telephone Exchange has been sold to W. T. Love, of the Piedmont Telephone Company of Gastonia, N. C.

GRAND FORKS, N. D.—A telephone franchise has been granted by the City Council to Fred. G. Wells, who represents a Chicago firm.

OTTAWA, OHIO.—The council has granted a franchise to the Farmers' Home & County Telephone Company which will build an exchange.

TREMONT, OHIO.—The Rosewood Telephone Company will build a line to Tremont giving connection with Urbana and other neighboring towns.

OBERLIN, OHIO.—The Oberlin Telephone Company has elected officers as follows: E. P. Johnson, president; C. K. Whitney, treasurer, and A. S. Root, secretary.

CADMUS, OHIO.—I. H. Champer, of Patriot, has organized a company and will establish telephone communication between the two villages, with rural service throughout the district.

COLUMBUS, OHIO.—The Auglaize Telephone Company has increased its capital stock from $5,000 to $15,000. Improvements will be made. Harper Stiles is general manager of the company.

McCOMB, OHIO.—C. Cotterman, of Deshler, has been granted a franchise to establish an independent telephone exchange. The town already has one exchange which is owned by Miss Angie Fruckley, the only woman manager in Ohio.

NORTH LIMA, OHIO.—The Beaver Telephone Company has elected officers as follows: W. H. Ruhlman, president; R. B. Metzler, treasurer, and John Yoder, secretary. The company has recently commenced operations with 100 subscribers.

BELLEFONTAINE, OHIO.—At a recent meeting of managers, J. O. Angell, of the Belle Center exchange of the United Telephone Company, was awarded a prize for the greatest increase in the number of subscribers during the year. The increase was from 52 to 103.

CLEVELAND, OHIO.—It is announced that Henry A. Everett is figuring on buying from the Federal Telephone Company its interest in the Stark County Telephone Company, one of the most important of the Federal properties. The company has about 2,000 telephones, with exchanges at Canton, Alliance and other towns in Stark County. The company has $500,000 capital stock, over half of which is owned by the Federal Company.

WARREN, OHIO.—At the recent annual meeting of the Warren & Niles Telephone Company the following directors were elected: C. C. Clawson, Jules Voutrout, Jr., C. B. DeVoe, C. W. DeVoe, J. J. McLean, Washington Hyde and C. B. Shelby. The company had a very prosperous year and there are now 935 telephones in Warren and vicinity and 400 in Niles and vicinity. The company's earnings will be used for improvements and all iron wire in the two systems will be replaced with copper.

CINCINNATI, OHIO.—C. R. McCracken, president of the newly-organized Cincinnati Telephone Company has applied to the Board of Legislation for what is equivalent to a franchise. In his letter to the authorities Mr. McCracken claims that under the decisions of the Supreme Court in the Zanesville case, the State has already granted by operation of law the use of the streets of the city to this company, and the only duty involving upon the city authorities is to agree with the company on the mode of using the streets. The company proposes to erect pole lines throughout the residence sections and is willing to place wires underground in the business sections. The outcome of the company's demand will be watched with interest since Cincinnati is the only large city in Ohio without independent service. It is claimed to be a serious handicap since there are more independent telephones in the State than Bell. It is claimed that Cleveland with 381,000 population has 20,174 telephones while Cincinnati with 325,000 population has only 6,868.

CHATTANOOGA, TENN.—The new system of the Cumberland Telephone Company, at Chattanooga, went into effect Jan. 1. The company is now occupying its handsome building and every feature of the service is new.

ALBANY, TEXAS.—The Albany Telephone Company, capital $25,000, has been incorporated to construct and maintain a telephone line in the counties of Shackleford, Eastland, Stephens, Haskell, Stonewell, Kent, King, Dickins and Garza. Incorporators, G. T. Renolds, of Ft. Worth; L. S. Hallowell and A. W. Reynolds.

OGDEN, UTAH.—The fight is on in the Ogden City Council between the Bell Telephone Company and the Home Telephone Company over the franchise asked for by the latter people. Public sentiment is about equally divided.

CHIPPEWA FALLS, WIS.—At a meeting of the stockholders of the Chippewa County Telephone Company it was decided to extend the line into the city in the Spring and establish an exchange.

MILWAUKEE, WIS.—The Morley Telephone Company, of Mt. Ida, Grand County, has been incorporated; capital stock, $800. Incorporators, Sylvester Frey, August Walner and H. A. Monteith.

LA CROSSE, WIS.—L. W. Stanton, a Cleveland engineer, has completed plans for the new exchange of the La Crosse Telephone Company. The ultimate capacity will be 3,000 lines and all contracts will be placed at once. Mr. Stanton will supervise the installation.

ELECTRIC LIGHT AND POWER.

PHOENIX, ARIZ.—Arthur Powell Davis, of the Hydrographic Bureau of the Geological Survey, has prepared plans for an enormous dam to be constructed in the Tonto Basin under the National Irrigation Act, provided feasible working methods can be presented to the Secretary of the Interior. The dam will make possible the irrigation of the total area of the Salt River Valley. It will be 240 feet high and will become part of a reservoir that will store, together with the regular flow of the Salt and Verde rivers, an ample supply of water for 250,000 acres. A power tunnel and a power house below the dam will be features of the enterprise, and it is hoped to generate 1,500 hp, more than enough to do the work of construction. Later this power will be electrically transmitted to the valley near Phoenix, where it will be used in pumping underground water, that the greatest possible extension of the irrigated area may be secured.

SAN BERNARDINO, CAL.—Ex-Judge Campbell, of this city, who recently secured a franchise from the Lytle Creek Water & Improvement Company, of Rialto, for electrical power purposes, has succeeded in placing bonds for the development work. The building of a large reservoir for equalizing heads of water in irrigating will be commenced at once.

DENVER, COLO.—An electric light company of Denver, Colo., represented by G. Revallier, has asked the authorities of Canyon City, Ore., for a 25-year franchise for a pole line. It is the company's purpose to install an electric lighting plant to supply the city. It is also intended to light Prairie City and John Day.

RATHDRUM, IDAHO.—A. W. Post, of Rathdrum, is at the head of a project to put in a plant to furnish light to that town. His company owns a water-power site near here.

SHELBYVILLE, IND.—The Citizens Heat, Light & Power Company, of this city has been organized. The capital stock is $100,000. The company will build a substantial plant during the summer.

CHEBOYGAN, MICH.—W. and A. McArthur have secured the right to build a dam and locks in the Black River for the purpose of erecting a large water power plant for the electric illumination of Cheboygan.

ADRIAN, MICH.—The city of Adrian has closed a contract for street lighting with the local company for a term covering five years and the number of lamps has been increased. This is the outcome of an agitation for municipal ownership, extending over a period of six months.

ROCHESTER, N. Y.—New York and New Jersey capitalists have organized the Rochester Light & Power Company. The capital stock is $500,000 and the directors are Edward J. Patterson, of this city; Harry L. Snyder, of Montclair, N. J.; G. L. Wakefield, Francis P. Ross and Samuel S. Perry, all of New York. The incorporation of this company was briefly noted last week.

MT. AIRY, N. C.—The town of Mt. Airy has voted $50,000 for water and lights, including a power plant.

HICKORY, N. C.—M. E. Thornton has bought out the Hickory Electric Company, including the lighting plant and will enlarge and improve the property. The name of the new concern is Thornton Light and Power Company.

CHARLOTTE, N. C.—Samuel J. Stowe, superintendent of roads and bridges in Mecklenburg County, N. C., is organizing a $1,000,000 company for the electrical development of Bluitt's Falls on the Pee Dee River near Rockingham, N. C., to furnish power to neighboring towns. It is estimated that 12,000 horse-power can be developed. C. W. Tillett, Charlotte, N. C., is a member of counsel for the company.

PIQUA, OHIO.—The council has granted Homer T. Bailey the right to construct and operate an electric light plant.

CANTON, OHIO.—The Canton, Light, Heat & Power Company has reduced its rates to take effect February 1. The company has recently installed new equipment in its power house and will make an effort to popularize electricity for family use.

CLEVELAND, OHIO.—Mayor Tom L. Johnson is holding up the contract with the Cleveland Electric Illuminating Co. for furnishing 5,000 street lamps and Professor Bemis, of the water works department, is preparing a report of experiences of cities conducting municipal lighting. Mayor Johnson aims to establish a lighting plant in connection with the new water works station.

YORK, PA.—The sub-station of the York Haven Water & Power Company, near this city, is being equipped with the necessary apparatus. The company is placing everything in readiness for the transmitting of electrical power from York Haven to this city. A large number of the local industries will be run by the electrical power from the York Haven plant.

COLUMBIA, S. C.—The Columbia Water Power Company will put in a new 1,300-hp generator and two turbine wheels to secure additional power.

NASHVILLE, TENN.—The city of Nashville has paid the last installment of $25,000 on the electric light plant, which now comes under municipal ownership.

RICHFIELD, UTAH.—The citizens of Richfield are contemplating the installation of an electric light system in that town. Nelson Baker is promoting the enterprise.

RICHMOND, VA.—There is some talk of establishing an electric light plant in the city hall.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham, Railway, Light & Power Company has let the contract for putting in its steam heating plant to the American Distrist Steam Company, of Lockport, N. Y. The plant will be run in connection with the large central power house of the company, located in Powell Avenue.

DETROIT, MICH.—It is stated that an electric railway between the Soo and St. Ignace will be built early in the spring by the Falk Company, which built Sault Ste. Marie's electric street railway last summer. It is said that the financing of the road will be done by Pennsylvania interests.

FAYETTEVILLE, N. C.—A syndicate will apply for a charter to build an electric railway in Fayetteville.

FARGO, N. D.—The City Council has granted franchises to the Fargo & Moorhead Street Railway Company. The company is capitalized at $250,000.

CLEVELAND, OHIO.—The earnings of the Lake Shore Electric Railway for November were $42,540, a gain of $14,762 over the same month last year.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Railway Company has increased its capital stock from $600,000 to $725,000, to provide for contemplated improvements.

CINCINNATI, OHIO.—Philip C. Swing, of the Cincinnati & Columbus Traction Company, has applied for a franchise along the Madison Pike, between Oakley and Madisonville.

PORTSMOUTH, OHIO.—At a recent meeting of stockholders of the Ohio Valley Traction Company it was decided to extend the line from Sciotoville to Ironton, where it will connect with the Camden Interstate Railway system.

COLUMBUS, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company has secured a contract from the post office authorities to handle mail to and from Etna, Reynoldsville, Kirkersville and Wagram.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company is planning important extensions, including a branch to New Cumberland and an extension of the Toronto road to connect with one building south from East Liverpool.

SPRINGFIELD, OHIO.—The Dayton, Springfield & Urbana Railway Company has obtained a lease upon all the property of the Urbana, Bellefontaine & Northern Railway Company, for a term of 30 years. Both roads are the property of the Appleyard syndicate.

COLUMBUS, OHIO.—It is reported that the Appleyard syndicate, which owns the Central Market Street Railway system of local lines, is planning to absorb the system of the Columbus Railway Company. The report is denied by officials of the latter company.

COLUMBUS, OHIO.—The reported purchase of the Bellaire, Zanesville & Cincinnati Railroad (steam) is denied by the Appleyard officials at Columbus. It was stated that a portion of the road was to be equipped with electricity, giving the syndicate connection with Wheeling, W. Va.

TOLEDO, OHIO.—The Toledo & Western Railway Company has made a contract with the Postal Telegraph Company whereby telegraph offices will be established in all the stations on the line of the road. The dispatching on the road will be done by telegraph, supplemented by the telephone.

CINCINNATI, OHIO.—The Cincinnati Intramural Railroad Company, of Cincinnati, has been incorporated, with $1,810,000 capital stock, by J. H. Woodward, J. S. Trevor, J. G. Wright, Charles B. Wing and W. C. Rodgers, to construct an electric railway within the city limits of Cincinnati.

HURON, OHIO.—The Lake Shore Electric Railway Company has finally adjusted the long standing difficulty relative to the use of the Huron River bridge, which for more than a year has held up the operation of through cars from Cleveland to Sandusky via Huron. As soon as the old bridge can be strengthened, cars will be operated through from Cleveland to Sandusky without change.

CLEVELAND, OHIO.—The Alliance Street Railway Company and the Stark Electric Railway Company have consolidated under the name of the Stark Electric Railroad Company. The capital stock of the consolidated company is $1,000,000, and the principal office is at Alliance. The following officers have been elected: C. R. Morley, Cleveland, president; David Morrison, Cleveland, vice-president; R. S. Cook, secretary; Edward Weibenson, Cleveland, treasurer. The above, with F. Straus, of Cleveland, are directors.

TOLEDO, OHIO.—As has already been announced, the Toledo & Western Railway syndicate, which is headed by Luther Allen and Judge C. M. Stone, of Cleveland, and F. R. and J. R. Seagrave, of Toledo, has in mind a through electric railway from Toledo to Chicago. This has assumed tangible form through the announcement of the successful financing of the Garrett, Auburn & Northern Railway and the Chicago & Indiana Air Line. These roads are being promoted by interests which are closely allied with the Toledo & Western Railway, and in connection with the Indiana Railway, an independent line, will form the desired connection.

COLUMBUS, OHIO.—The Ft. Wayne & Springfield Railway Company has been incorporated, with $250,000 capital stock, by W. H. Fledderjohann, B. H. Fledderjohann, John H. Koenig, Henry J. Hoppel and C. Voght. It is proposed to construct an electric railway from Ft. Wayne, Ind., to Springfield, O. It is believed this is one of the projects of the Bushnell syndicate of Springfield.

CLEVELAND, OHIO.—The final steps in the reorganization of the Northern Ohio Traction Company into the Northern Ohio Traction & Light Company were made at Akron a few days ago. Officers of the new company were elected as follows: Henry A. Everett, president; Will Christy, first vice-president; Charles Currie, second vice-president and general manager; C. F. Moore, secretary, and J. R. Nutt, treasurer. These officers, with E. W. Moore, Barney Mahler and Charles Wason, comprise the board of directors. The property has been formally transferred to the new company.

PITTSBURG, PA.—The Pittsburg, McKeesport & Connellsville Railway Company has decided to extend its Leisenring Division to Vanderbilt and thence to

Dawson. The contract will amount to about $70,000. The line will be single track, with turnouts, and will be of steam railway construction.

MEMPHIS, TENN.—A deal has been on for the sale of the Memphis street railway property by F. G. Jones and C. K. G. Billings. Hart Newman, of Newman Bros., New Orleans, is the prospective buyer. The amount involved is about $7,000,000.

CLARKSVILLE, TENN.—It is said that Chicago capital is backing the proposed electric railway from Clarksville, Tenn., to Hopkinsville and Guthrie, Ky. It is further reported that contracts are being made for material and that work will begin early next spring.

RICHMOND, VA.—The Railway and Light Company of America, of which R. L. Williams, of Richmond, is first vice-president, is enabled this year to pay dividends on several acquisitions where no dividends were previously paid. The Knoxville Traction Company will pay a semi-annual dividend of 1 per cent., the Lexington railway will increase its semi-annual dividend from 1 to 1½ per cent. The Macon, Ga., property bought by Mr. Williams and others will pay its first semi-annual dividends of six per cent. on preferred stock. The net earnings on the Macon property are given out at $47,378.44, with a surplus of over $15,000.

CHARLESTON, W. VA.—The South Parkersburg Electric Railway Company has been incorporated, with $100,000 capital stock.

NEW INDUSTRIAL COMPANIES.

THE ROYAL CARBON COMPANY has been incorporated at Marietta, Ohio, with a capital stock of $100,000, by O. L. Gard, B. B. Stoney, G. L. Lund and Wm. Morse.

THE ELBLIGHT COMPANY OF CALIFORNIA has been incorporated in New Jersey with a capital of $75,000 by Kenneth K. McLaren, H. O. Coughlan and Louis B. Dailey.

THE ELECTRIC IRRIGATION COMPANY, capital $1,000,000, has been incorporated in South Dakota by George J. Reed, J. N. Lucas, Chicago, Ill.; Philip Lawrence, South Dakota.

THE ELECTRIC CAR LIGHTING COMPANY, capital stock $100,000, has been incorporated by Roswell S. Nichols, Lucius E. Varney, Anthony N. Jeshera, John M. Scoble and John Mulford Enright.

THE ELECTRA MANUFACTURING COMPANY has been incorporated in New Jersey to manufacture electrical devices; capital, $250,000. Incorporators: Frederick A. Feldkamp, Frederick C. Fraentzel, Geo. Heinkel.

LEGAL.

WESTERN UNION FIGHT ON THE PENNSYLVANIA.—The Western Union Telegraph Company has filed a bill in the Federal Court to restrain the Pittsburg, Cincinnati, Chicago & St. Louis Railway from carrying out its expressed intention of preventing the operation of the Western Union Telegraph on its lines after June 2 next. Judge Kirkpatrick's opinion in a like case is given on page 146 of this issue.

TO ENJOIN DAM BUILDING.—Argument is being heard in the United States Court at Indianapolis in the case of the St. Joseph Navigation Company for an injunction against the St. Joseph and Elkhart Power Company to restrain the building of a dam across the river. The power company had up to the time of filing the suit expended $550,000 on the dam and when completed it will cost a million dollars. The purpose of the company is to construct a large electric power plant and furnish electric power to manufacturers and others within a radius of several miles. It is not believed that such a great improvement will be restrained by the court.

OBITUARY.

M. GOUBET.—A cable dispatch from Paris states that M. Goubet, whose electric submarine boats were refused by the French Government and who was committed to an asylum a few days ago, is dead.

MR. R. POOLE.—Robert Poole, President of the Robert Poole & Son Company, iron founders, died at Baltimore, Md., on January 15, aged seventy-five. Among the larger engineering feats accomplished by the company of which Mr. Poole was the head was the erection of the dome of the National Capitol at Washington from plans drawn by Mr. Poole. During the civil war the firm manufactured many cannon for the Federal army, among them the famous "double-enders," which were invented by the head of the firm. Mr. Poole was noted for his charities.

PERSONAL.

MR. GEORGE WESTINGHOUSE returned from Europe this week.

MR. J. CHARLES YOUNG, of the Woodward Governor Company, Rockford, Ill., was a recent visitor to New York City.

MR. FRANK WELZ, electrical engineer, has become connected with the department of electricity at the World's Fair, St. Louis.

M. CHOLOGOHOFF, of the Societe Anonyme Westinghouse, St. Petersburg, sailed this week for Europe after a four months' visit to the United States. While here he spent most of his time in the Westinghouse plants at Pittsburg.

MR. AUGUST BELMONT is to become president and Mr. Alfred Skitt will remain in charge of the Manhattan under the Interborough control.

MR. H. C. WARREN has been appointed general manager of the Toledo & Indiana Railway, at Toledo, Ohio. Mr. Warren has had long experience with steam railroading.

MR. CHARLES CLEGG, manager of the Mexico Electric Tramways Limited, of London, which concern operates the American equipped electric traction system in the City of Mexico, was in New York last week. He has now returned to Mexico.

MR. HAYDN EAMES, of the automobile department of the Westinghouse Electric & Mfg. Co., is to deliver an address on Tuesday evening, January 27, before the Automobile Club of America on the situation in regard to the development and introduction of business automobiles.

CHIEF ENGINEER BRAIN, of the government railway lines in New South Wales, recently visited San Francisco. He was the guest of local street railway officials. Mr. Brain will have much to do with the equipping of the extensive electric railway lines projected in Australia.

MR. F. H. PARK, of the Societe Anonyme Westinghouse, St. Petersburg, who has been in America for the last three months, will remain about a month longer. He is making his headquarters at the offices in the Maritime Building, Bridge Street, of Westinghouse, Church, Kerr & Company.

MAYOR TOM JOHNSON, of Cleveland, has been under examination in a suit in which the administrators of his brother, the late A. L. Johnson, and Mayor J. M. Edwards, are suing for $260,000, in connection with the Nassau trolley system, of Brooklyn, N. Y. The Mayor was nominal treasurer of the road.

MR. ANTHONY BRADY, Geo. D. Knapp and C. K. Billings, of the People's Gas, Light & Coke Co., of Chicago, who went over to Paris to look over the gas and electric power situation with the view of a merger of several companies, have started for the United States. They will return to Paris in March.

MR. W. S. CHASE, formerly treasurer of the Cleveland Machine Screw Company, has become sales manager for the National-Acme Manufacturing Company, of Cleveland, Ohio. In his former position Mr. Chase formed a wide acquaintance with the automatic screw machine trade of the country that is of great use to him and his friends.

MR. CHARLES M. WOOD, who has been connected with the California Electrical Works in San Francisco for twelve years, resigned his position as manager of the sales department at the close of last year to accept the position of President of the Century Electric Company. The latter company is doing a good construction and repair business, besides carrying the agency for the Gould Storage Battery and other lines.

MR. THEODORE P. GILMAN, First Deputy State Controller of New York State, resigned his office last week to accept the presidency of the General Electric Inspection Company, of New York. Mr. Gilman, in his letter of resignation, said that he resigned with personal and political regret, but that his recent election as president of the company made it impossible for him to continue in office. In accepting it Controller Miller said the deputy's service had been earnest and efficient. The salary of the office is $4,000, with $1,200 for expenses.

COL. ASHLEY W. COLE.—Representatives of the New York Merchants' Association and others interested in the improvement of general street railway facilities in New York City called on Gov. Odell last week and requested that, if he had any idea of supplanting Col. Ashley W. Cole as Railroad Commissioner, he would wait until the Board had made a decision in the matters now before them of the increase of cars on the various lines in the metropolis. The Governor replied that if he made a change he would certainly see that it did not interfere with the present investigation.

MR. CLARENCE H. MACKAY.—An appraisement of the personal estate of John W. Mackay, who died in London in July last has been completed. The estimated net value of the personal property is $2,451,726, the sum of $50,000 having been expended for executors' commissions and administration costs. All of the personal estate under Mr. Mackay's will goes to his son, Clarence H. Mackay, but a large part of the property is inherited by the widow, Mrs. Marie Louise Mackay. According to the appraisers, there is no real estate listed in New York. The personal property includes: Bonds of the Sprague Electric Company, $279,500; 3,112 shares American Telegraph & Telephone Company, $513,480; 6,676½ Commercial Cable Company, $1,071,578; 1,994½ Commercial Cable Building Company, nominal; 1,639½ Telephone & Telegraph Company, $47,135; 55 Maurice Grau Opera Company, $27,500; 750 New York Quotation Company, $71,250; 425 $1,000 bonds Commercial Cable Company, $425,000; 50 $1,000 bonds Commercial Cable Company, $50,000; cash in bank, $11,018; books, pictures, etc., $5,263.

MR. W. E. RUNDLE, who is connected with the Interborough Rapid Transit Company, of New York City, has recently drawn up for the National Conduit & Cable Company an ingenious form of chart for one of the extensive London installations which this company is making. It shows graphically, by sections, each and every cable throughout a city or town; which duct each particular cable is in; a key map of the section of city shown and number of cables from power house to manholes; cable ordered but not forwarded; cable in town but not laid; cable drawn into duct, with reel number, month, day and year, also foreman drawing in cable into duct; two cables in one duct; numbers of manholes or street names; diameters of manholes; distances between manholes; cable jointed, with month, day, year and name of man making joint; switch pillars, with terminal head, giving date put on and by whom, and without terminal head; also duct length or cable drawn into switch pillars. By the use of two colors the chart shows the exact status of the work as it progresses from day to day, to the jointer, to the superintendent of construction, and to the home office.

EDUCATIONAL.

WELLESLEY COLLEGE is to have, through the generosity of Mr. John D. Rockefeller, an entirely new and up-to-date power plant. Apparatus will be installed for heating all the buildings on the college grounds, which extend over several acres, and the grounds will be lighted by electricity throughout. Electric motors also will be used for operating elevators and blowers for ventilation purposes. Mr. Rockefeller has recently purchased from the Westinghouse Electric & Mfg. Co., for this plant, two alternating-current, engine-type, two-phase alternators, separately excited, one of 150-kw. and one of 75-kw. also a five panel switchboard.

NEW YORK LECTURES.—In the Board of Education popular lectures, Prof. E. R. Von Nardoff lectures on electricity in Cooper Union on Wednesday nights and at the American Museum of Natural History on Saturday nights. Prof. William Hallock, of Columbia University, lectures on physics on Wednesday nights at the Baron de Hirsch Trade School, 222 East Sixty-fourth Street. W. W. Ker lectures on electricity at the Young Men's Hebrew Association, Ninety-second Street and Lexington Avenue, on Wednesday nights and at Columbus Hall, Sixtieth Street and Columbus Avenue, on Thursday nights. Prof. John S. McKay lectures on heat at St. Bartholomew Lyceum Hall, 205 East Forty-second Street, on Saturday nights, and at Public School No. 158, Avenue A, between Seventy-seventh and Seventy-eighth Streets, J. Newton Gray lectures on physics on Friday nights.

LEHIGH UNIVERSITY REGISTER.—The Register of Lehigh University, South Bethlehem, Pa., just issued, shows the attendance of 581 students from 27 states and 6 foreign countries. There are 52 in the teaching staff. Twelve courses of instruction are offered at the university: the classical course, the Latin-scientific course, courses in civil, mechanical, metallurgical, mining, electrical and chemical engineering, analytical chemistry, geology, physics and electro-metallurgy. One hundred and five students take the course in electrical engineering. A list of the graduates of the university, 1,248 in number, during the 37 years of its existence, indicates that this institution is exerting a very marked influence on the industrial development of the United States, and also of foreign countries. The following prize scholarships will be open to competition at the annual examinations in June: Two in the classical course of $150 and $100 each, and one in the Latin-scientific course of $125 annually, in addition to free tuition. Provision is made for worthy and needy students whereby they may postpone payment of tuition until after graduation.

Trade Notes.

THE PRAIRIE CITY ELECTRIC COMPANY, of Prairie du Chien, Wis., has increased its capital stock from $10,000 to $20,000.

THE SIMPLEX ELECTRICAL COMPANY, Boston, Mass., has changed its address from 75 Cornhill to 110 State Street, that city.

THE COLONIAL STEEL COMPANY, Pittsburg, has just ordered a large oil filter from the Burt Manufacturing Company, of Akron, O., for use in the new steel works which it has just erected.

THE MARIETTA MANUFACTURING COMPANY, Marietta, O., has secured the contract for the installation of electric light plants, engines, boilers, etc., for seven new Ohio River steamboats to be built this winter.

THE WARREN ELECTRIC & SPECIALTY COMPANY, Warren, Ohio, has elected the following named directors: T. H. Gillmer, president; C. H. Angstadt, vice-president; E. W. Gillmer, secretary-treasurer; J. W. Holloway and C. B. Selby.

REMOVAL.—The Cochrane-Bly Machine Works, Rochester, N. Y., have removed their factory to larger quarters at Nos. 7-11 Griffith Street, that city. The new plant gives the company the enlarged facilities which it required in order to meet with the increasing demand for its goods. This company manufactures die-making machinery.

THE ELECTRO DYNAMIC COMPANY, of 212 Ionic Street, Philadelphia, has issued in a handsome 4-page pamphlet the article which appeared in ELECTRICAL WORLD AND ENGINEER, illustrating and describing the Pfatischer system of electrical steering gear introduced with so much success on board the Red Star liner *Finland,* and other steamers, as well as in the Russian navy.

THE STERLING ELECTRICAL MANUFACTURING COMPANY has increased its capital stock from $50,000 to $100,000. Mr. G. C. Webster of the company is quoted as saying that it is the purpose of the company to increase its output to 10,000 lamps per day, or about double its present capacity. New buildings will be erected in the spring and new machinery will be installed.

COATING MACHINES.—F. E. Hook, of Hudson, Mich., the originator of the pneumatic coating machine for painting and whitewashing, has succeeded to the painting machine business of the Bean-Chamberlin Manufacturing Company, of the same place, and will in the future sell its machines in connection with his own "Best" pneumatic coating machines and "Stay There" paints.

UNIVERSAL DRAFTING MACHINE.—Draftsmen will find very interesting the catalogue of the Universal Drafting Machine Company, of Cleveland, Ohio, which, by means of excellent illustrations, shows the wide range of application of this handy instrument. This machine was described and illustrated in ELECTRICAL WORLD AND ENGINEER of December 6, 1902.

LOMBARD GOVERNOR COMPANY, of Boston, has issued a very handsome calendar for 1903, which, in view of the fact that it makes a well-known type of successful governor for water wheels, has naturally a water subject for its illustration. The scene is a moonlight view of calm sea and sailing boats, suggestive of the tranquility enjoyed by the man whose wheels are regulated by a Lombard.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been appointed general sales agent for the Toler system of conduit boxes. This line of boxes is extensive enough to meet every possible condition, no matter what size, shape or style. A complete catalogue now in press will be ready for distribution in a few days. This should be in the hands of every electrical man, and a copy will be mailed upon application.

INCANDESCENT LAMP FITTINGS.—The Incandescent Electric Light Manipulator Company, 116 Bedford Street, Boston, Mass., has issued a descriptive circular of a number of specialties of its manufacture, including a lamp replacer, switch and socket key manipulator, Morse cord lamp adjuster, bulb cleaner and Webster lamp adjuster—all conveniences for users of incandescent lamps.

THE MECHANICAL BOILER CLEANER COMPANY has just received a letter from the Omaha & C. B. Railway & Bridge Company, stating that the Garrigus cleaners put in its boilers in 1898 are still working perfectly. It also says that the cleaners are essential to the economical operation of any boiler and that it has found that by using the cleaners the boilers are more efficient and expense greatly reduced.

TELPHERAGE.—Circulars Nos. 30 and 31 of the United Telpherage Company, 20 Broad Street, New York, have for titles, "Telpherage for Manufacturers" and "Telpherage in Freight Yards." The first-mentioned contains illustrations of telpherage applications for conveying coal, cotton bales, boxes and freight packages. The illustrations in the latter refer to installations made on docks and in railroad yards and freight houses.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., devotes two of its latest bulletins to "Automatic Start Induction Motors" for single-phase current and "Forge and Volume Blowers." The motors are rated at 1-20 and 1-10 hp, and are specially adapted for dental work. The second bulletin relates to centrifugal blowers, which comprise eight sizes for six different frequencies the ratings being from 1-10 to 1-3 hp.

THE W. G. NAGEL ELECTRIC COMPANY, of Toledo, Ohio, has recently taken the agency of the Duncan recording wattmeter. These meters are of the commutator type, direct or alternating current, having an aluminum case and possessing many new and up-to-date features. Duncan meters are direct reading in all sizes and are especially desirable for direct current lighting and power circuits. Prices will be gladly quoted upon application.

NORMAN HUBBARD'S SONS are now located at 265 Water St., Brooklyn Borough, New York. They will continue to manufacture the Packard vacuum pump, so extensively used in the electrical field. Mr. R. D. Hubbard has had an experience of more than twenty-five years in this and kindred lines. The Packard vacuum pump now possesses all the improvements that make it as perfect as skill and workmanship can accomplish. The firm's new price list is now ready.

SAFETY INSULATED WIRE & CABLE COMPANY, of 114 Liberty Street, New York, has got its new factory at Bayonne, N. J., into full swing, and states that it is the largest rubber insulating plant in the world. It laid recently a 550-mile deep sea cable in the Mexican Gulf, and has supplied over 2,000 miles of cable to the Government for the Philippines. It has over 12,000 miles of high-tension cable in use in different parts of the United States and has large orders ahead for light, power, trolley and telephone work.

CRESCENT SOLDERING MATERIAL.—The Crescent Electric Company, Chicago, Ill., is making soldering material which embodies some new and advantageous features. The Crescent soldering stick is a compound moulded into stick form, possessing the advantages of such form and at the same time eliminating the annoyance due to breaking up and crumbling. Being partially flexible it can be carried in the tool bag without danger of its breaking up into small unusable pieces. This material is also made in paste form and put up in 2-oz. tin boxes. Economy is claimed for it, as little is required on each job; another advantage being its freedom from corrosive acids.

ASBESTOS PACKING.—A ring of wire insertion asbestos high-pressure packing that was in constant use for six years, will be shown by the H. W. Johns-Manville Company, 100 William Street, New York, to anyone interested. During its long service the packing, which was recently removed from the steam end of a Worthington duplex compound pump, used in the elevator service of the Woodbridge Building, New York, never caused the engineer the slightest trouble. When removed it was in such excellent condition as to permit of further efficient service, notwithstanding its six years' use. The rod is still perfectly smooth. The packing worked under 125 pounds pressure; pump capacity, 3,000,000 gallons every twenty-four hours.

THE FOUR-TRACK NEWS for January is an excellent issue, as a casual glance over its contents will convince all readers. An idea of its variety may be gained from the following partial list of subjects: "Mount Hood," and "Solemn Barred Owls," and "An Autograph of the Ice Age," and "The Climbing Bear Tree." There are "Vest Pocket Confidences," by the editor, and "How Royalty Travels," by Andrew D. Titus. "In the Trail of the Traveler" will well repay perusal, and there are jokes and poems that will cause the appreciative reader to fancy that his salary has been raised and that everything is gold that glitters. It is fitting literature to peruse while traveling on such trains as the Empire State Express or the Twentieth Century Limited.

ASBESTOS CATALOGUE.—The 1903 Asbestos catalogue of the H. W. Johns-Manville Company, 100 William Street, New York, is a handsome booklet of 100 pages. The half-tone illustrations, numbering nearly 150, show asbestos in many conditions, from the natural state, as it is mined, to the various non-conducting forms into which it is manufactured for both heat insulation and refrigeration; packing for all conditions of service; asbestos paper and millboard for fireproof construction; electrical insulation, heat and cold insulation, fire-resisting cements and sundries, such as fireproof theatre curtains, asbestos gloves, and household articles. There seems to be hardly a trade in which some use is not made of asbestos; in fact, the list of over 300 buildings, manufacturers, etc., using the company's products includes firms prominent in every line of industry. The arrangement of the catalogue is such that quick reference may be made to any article. Each section has its own table of contents and there is also a complete alphabetical index. In addition to the attention given to the technical details the books is attractively printed in two colors, with a striking cover design in blue and white. Additional strength is given to the illustrations by a novel arrangement of rules about them. A copy may be obtained by addressing the company's New York office or any of the branch offices.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JANUARY 13, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

12,073. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed May 20, 1902. The object is the provision of means by which the wave responsive device is completely protected from the powerful radiations of the transmitting apparatus located at the same station.

718,068. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. The branch circuits from the main to the sectional conductors, which include the actuating coils of the cut-outs, are completed in shunt to the car motors successively by the passing car, said shunt relationship being maintained while the motors are receiving current through the switches controlled by the coils in said circuits.

718,069. ELECTRIC RAILWAY; F. M. Ashley, Brooklyn, N. Y. App. filed Feb. 26, 1898. The switch coils located in the branches connecting the mains with the corresponding sections of the working conductor are connected in series.

718,071. ELECTROMECHANICAL AUTOMATIC SIGNALING AND COLLISION PREVENTING DEVICE; C. S. L. Baker, St. Joseph, Mo. App. filed Aug. 25, 1902. Details.

718,076. BATTERY; L. Begeman, Cedar Falls, Iowa. App. filed Jan. 7, 1902. The depolarizing agent is embedded in the meshes of a wire netting arranged around the walls of the cell.

718,083 and 718,084. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, N. Y. App. filed June 22, 1896. (See Current News and Notes.)

718,093. TELEPHONE-JACK; H. P. Clausen, Chicago, Ill. App. filed May 8, 1902. (See page 159.)

718,177. CONTROLLER FOR ELECTRIC MOTOR DRIVEN PUMPS; T. Trolsen, Brooklyn, N. Y. App. filed July 5, 1902. Details.

718,182. ELECTRICALLY CONTROLLED ORGAN BELLOWS; E. R. Whitney, Lynn, Mass. App. filed June 21, 1901. A spring is put under tension by the opening movement of the bellows to give a quick movement to the cut-out switch.

718,183. ELECTRIC RAILWAY SYSTEM; G. T. Woods, New York, N. Y. App. filed Oct. 30, 1896. In an electric railway having electromagnetic track switches controlling the flow of current from the track system to the car motor system, a shunt from the motor system for energizing the magnets of the track switches, and a motor generator on the car having the armature of its motor side in said shunt and having its generator side so connected to the car motor system that the work and therefore the counter electromotive force of the motor generator armature is regulated.

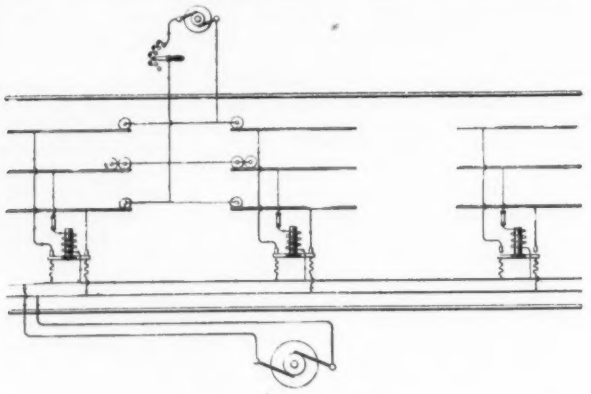
718,204. TELEPHONE; M. R. Hutchinson, New York, N. Y. App filed November 15, 1901. (See page 159.)

718,205. ELECTRIC BATTERY; M. R. Hutchison, Upper Montclair, N. J. App. filed April 5, 1902. Porous material in intimate contact with the plates projects into a reservoir of free liquid in the bottom of the cell, the top of the cell being sealed and provided with a capillary vent for gases.

718,212. ELECTROMECHANICAL MOVEMENT; E. S. Lorimer, Piqua, O. App. filed March 8, 1902. An automatic device for opening the circuit of a clutch magnet when the driven element has been moved to the desired extent.

718,215. TELEPHONE-SYSTEM; I. H. Parsons, Leicester, and T. Sloper, Devizes, England. App. filed February 28, 1902. (See page 159.)

718,220. CONDUCTOR, CONDUIT AND COLLECTOR FOR ELECTRICITY ON RAILWAYS; R. C. Sayer, Bristol, England. App. filed Oct. 7, 1901.



718,068.—Electric Railway.

Plungers in the rim of a wheel act upon valves regularly spaced along a conduit to open the same successively and give access to a conductor therein.

718,224. INTERCOMMUNICATION TELEPHONE-SYSTEM; T. Sloper, Wilts, and I. H. Parsons, Leicester, England. App. filed April 18, 1902. (See page 159.)

718,233. ELECTRIC SIGNAL SYSTEM FOR RAILWAYS; J. W. Williams, Spokane, Wash. App. filed May 7, 1902. A combination of track and wire circuits arranged to operate signaling appliances.

718,235. POLARIZED TELEPHONE SIGNAL-BELL; E. E. Yaxley, Chicago, Ill. App. filed March 13, 1901. (See page 159.)

718,249. ELECTROLYTIC APPARATUS; M. Haas, Aue, Germany. App. filed August 6, 1901. To prevent short-circuiting of the current through the liquid of the cells, the liquid is caused to flow through elongated tubes of small cross section.

718,264. ATTACHMENT FOR TELEPHONE-MOUTHPIECES; J. F. Logue, Sacramento, Cal. App. filed September 8, 1902. (See page 159.)

718,310. TELEPHONE-TRANSMITTER; C. C. Cadden, Cleveland, Ohio. App. filed September 8, 1902. (See page 159.)

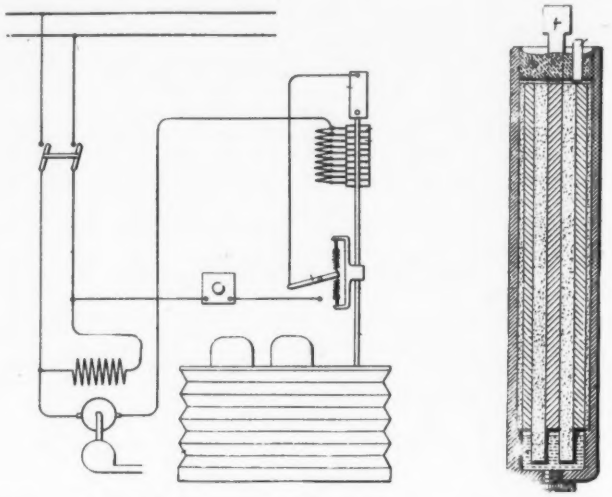
718,332. VISIBLE SIGNAL TELEGRAPH; W. A. Farrell, Wellsville, N. Y. App. filed April 7, 1902. A switchboard for operating varicolored lights arranged in groups on an upright support to signal letters by different combinations.

718,371. COIL-BOX FOR TELEPHONES; W. E. McCormick, Chicago, Ill. App. filed May 4, 1901. (See page 159.)

718,378. INSULATING LINING AND PROCESS OF MAKING SAME; G. B. Painter, Schenectady, N. Y. App. filed Oct. 6, 1898. The inside of the shell of a lamp socket is lined with a moulded cylinder of sheet fiber.

718,405. ELECTRIC CUT-OUT; C. Wagner, Brooklyn, N. Y. App. filed June 25, 1902. A tubular support for an electric lamp is provided at an intermediate point with a cut-out operated by twisting the lower end of the tube.

718,437. METHOD OF MANUFACTURING ELECTROLYTIC OR ELECTRIC LIGHT CARBONS; H. H. Dow, Midland, Mich. App. filed Nov. 6, 1899. A vaporous binder is deposited upon the carbonaceous article and the latter then moulded and baked.



718,182.—Electrically Controlled Organ Bellows. 718,205.—Electric Battery.

718,438. METHOD OF MANUFACTURING ELECTROLYTIC OR ELECTRIC LIGHT CARBONS; H. H. Dow, Midland, Mich. App. filed Nov. 6, 1899. The carbon material is mixed with an emulsion of a binder and a liquid.

718,455. METHOD OF TREATING GLOWERS FOR DIRECT-CURRENT ELECTRIC LAMPS; M. W. Hanks, Pittsburg, Pa. App. filed March 23, 1901. (See Current News and Notes.)

718,460. COMBINED SWITCH AND PROTECTING DEVICE; H. H. Hornsby and E. W. Anger, Jr., Chicago, Ill. App. filed Nov. 25, 1901. A base block carrying fuses and a snap switch is provided with branch connections leading along the back to connecting clips arranged in grooves adapted to receive the main wires.

718,485. APPARATUS FOR PURIFYING WATER; H. M. Livor, New York, N. Y. App. filed May 7, 1902. An electrolyzing chamber made of a single piece of insulating material with one electrode secured to the inner wall of the chamber and the other to the bottom of the same in such manner that all parts of the two electrodes are at all times concentric to each other.

718,489. SECONDARY BATTERY; J. W. Madigin, Toronto, Can. App. filed Feb. 5, 1902. Details.

718,495. SNAP SWITCH; G. A. Mead, Mansfield, O. App. filed Sept. 3, 1901. Details.

718,518. ELECTRIC MOTOR; E. S. Pillsbury, St. Louis, Mo. App. filed July 24, 1902. A self-starting alternating-current motor in which a centrifugal device short circuits the commutator and removes the brushes so that at normal or high speed the machine runs as an induction motor.

718,535. WIRELESS TELEGRAPH REPEATER; H. Shoemaker, Philadelphia, Pa. App. filed June 11, 1902. Means controlled by the wave responsive device for placing the aerial conductor into communication with a transmitter and means for isolating the responsive device during the operation of the transmitter.

718,544. TELEGRAPH SYSTEM; E. R. Storm, New York, N. Y. App. filed July 30, 1897. On the movement of a perforated strip impulses of like polarity but of varying duration acting through an induction coil are caused to induce momentary currents of alternately opposite polarity of equal duration, but at irregular intervals.

718,588. ELECTRIC MOTOR OR GENERATOR; J. A. Titzel, Sr., Franklin, Pa. App. filed Dec. 13, 1900. By an arrangement of a fragmentary field, comprising separate field magnets, the machine can be used as a direct-current dynamo or motor or as an alternating-current dynamo or motor.